THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXVII. No. 677.] LONDON, MAY 2, 1876. [28th Year.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—10,000 cubic feet of gas per ton of coal; 26-candle gas; 12¼ cwt. coke per ton of coal.

The London Exhibition in 1851 was lighted with gas made from Ramsay's Cannel.

RAMSAY'S PATENT CONDENSED GARESFIELD COKE.

RAMSAY'S ORDINARY GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1828. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwenthaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne.

Address G. H. Ramsay, Newcastle-on-Tyne.

London, at the Lombard Exchange, 39, Lombard St., E.C.

GENUINE TORBAY PAINT
AND
SPECIAL GASOMETER PAINT
(Mixed ready for use).

These Paints are now used in 100 Country Gas-Works, and by all (but one) of the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. They will cover tar effectually. Also used by the Admiralty, War Office, Railway Companies, Founders, &c.

They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.

The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov.* 2, 1868.

STEVENS & CO.,
(Successors to Samuel Calley. Established 20 Years.)
21, GT. WINCHESTER ST., LONDON.
Works: BRIXHAM, TORBAY.

THOMAS PROUD,
MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS
AND
PURIFIERS.

BROOKFIELD IRON-WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE,

Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas-Retorts and other Objects in Fire-Clay," and they were also awarded at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellence of Quality."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COALS.
Coal Office,
Quay Side, Newcastle-on-Tyne.

Jos. Cowen & Co. are the only Manufacturers of Fire-Bricks and Clay Retorts at Blaydon Burn.

JOHN RUSSELL AND CO.,
THE WEDNESBURY TUBE-WORKS, WEDNESBURY;
AND
THE ALMA WORKS, WALSALL.
Established at the commencement of Gas Lighting.

Warehouses:
69, UPPER THAMES STREET;
COMMERCIAL STREET, SPITALFIELDS;
5, CHARLES STREET, SOHO; and
16, SOHO SQUARE,
} LONDON
35, 36, 37, & 39, GRANBY ROW, MANCHESTER.

J. R. and Co. are the original manufacturers of Wrought-Iron Gas Tubes and Fittings, and Inventors of the LAP-WELDED TUBES for Locomotive and Marine Boilers.

J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water; Gun-Metal Cocks, Stocks, and Dies; Galvanised Tubes and High-Pressure Tubes, &c.

Lists may be obtained on application to
69, UPPER THAMES STREET, LONDON.

JOHN BENT & SON,
BELL BARN ROAD, BIRMINGHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
OF
FIRST-CLASS MATERIALS & WORKMANSHIP;
Also, STATION-METERS, PRESSURE-GAUGES, STREET-LAMPS, REGULATORS, &c.

Established 1830.

THOMAS PIGGOTT & CO.,
SPRING HILL, BIRMINGHAM.
MANUFACTURERS OF
TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
Sugar, Saltpetre, and all kinds of Pans.
Roofs, Girders, and Bridges, and General Smith's Work.
London Agent—W. G. DAVIS, 2, Brabant Court, Philpot Lane, E.C.

J. & H. ROBUS,
CONTRACTORS
FOR THE
ERECTION OF NEW & REMODELLING OF EXISTING GAS-WORKS.

RETORT-SETTING A SPÉCIALITÉ.

RETORTS SET, AND GUARANTEED TO BURN OFF A CERTAIN AMOUNT OF COAL OR ELSE NO MONEY TAKEN FOR THE CONTRACT.

PLANS ON APPLICATION.
Retort-Setters sent to all parts of Europe and America.
Address, J. and H. ROBUS,
BELL GREEN, CATFORD, LONDON, S.E.

THE
NITSHILL COMPANY'S
DUKE OF HAMILTON'S
LESMAHAGOW
CANNEL COAL.

AGENT:
JAMES M'KELVIE,
HAYMARKET,
EDINBURGH.

GEORGE GLOVER & CO.

PATENTEES OF THE

NATIONAL STANDARD GASOMETERS

FOR THE ENGLISH GOVERNMENT
AND FOR THE GOVERNMENT OF THE NETHERLANDS
AND OF THE DUPLICATE COPY
Presented by Her Majesty's Government to the French Government,
AND MANUFACTURERS OF

IMPROVED DRY GAS-METERS

Warranted to Measure correctly & not to vary.

RANELAGH WORKS, RANELAGH ROAD, PIMLICO, LONDON, S.W.

236, GEORGE STREET, GLASGOW, & 30, LANCASTER AVENUE, MANCHESTER.

FOREIGN AGENTS.
DAHL BROTHERS, COPENHAGEN. | W. HOVEN & SON, ROTTERDAM.
A. FAAS & Co. FRANKFORT O/M. | COPLAND & McLAREN, MONTREAL.
A. DEMPSTER, POST OFFICE PLACE, MELBOURNE.

SILVER MEDAL, PARIS EXHIBITION, 1867.

LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

MANUFACTURERS OF

WROUGHT-IRON TUBES AND FITTINGS

AND

LAP-WELDED IRON AND HOMOGENEOUS METAL BOILER TUBES.

Boiler-Tube Ferrules, Gun-Metal Gland Cocks, Water-Gauges, Whistles, &c.; Stocks, Taps, and Dies for Screwing, and Gas-Fitters Tools.

London Offices: No. 4, Cloak Lane, Queen Street, E.C.

WAREHOUSES:

LONDON: 157, UPPER THAMES STREET, E.C.

LIVERPOOL: No. 63, Paradise Street.
MANCHESTER: No. 7, Blackfriars Street, Salford.
PARIS: No. 38, Rue du Chateau d'Eau.
LILLE: No. 38, Rue Grande Chaussee.

1862.

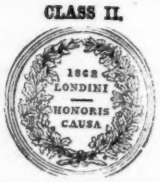
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.



This Paint having been in general use over fourteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

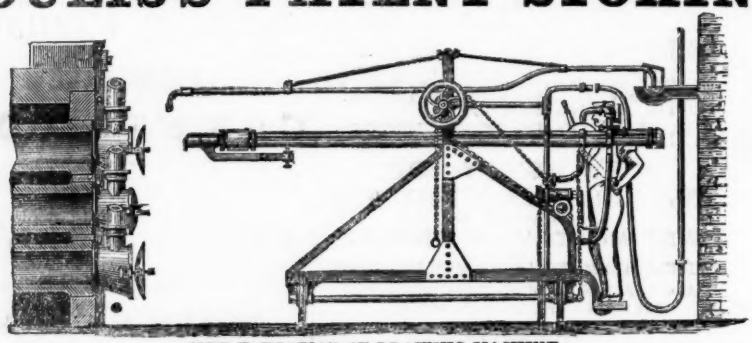
It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

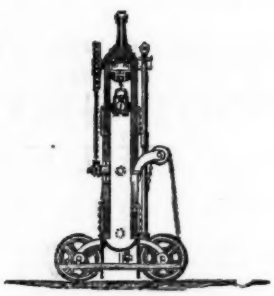
N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

SPECIAL DRIERS FOR ANTIMONY PAINT SUPPLIED.

FOULIS'S PATENT STOKING MACHINE.



SIDE ELEVATION OF DRAWING MACHINE.



END ELEVATION.

(*The Charging Machine will be Illustrated in next week's Advertisement.*)

Makers: TANGYE BROTHERS and HOLMAN, London and Birmingham; ADAM WOODWARD and SON, Manchester; ROBERT LAIDLAW and SON, Glasgow; MASCHINENBAU-ACTIEN-GESELLSCHAFT HUMBOLDT, Kalk bei Deutz; Or all particulars may be had from JAMES WOTHERSPOON, 31, St. Vincent Place, Glasgow.

TRADE MARK

THE MEDAL FOR 1862.

The only Prize Medal awarded for TUBES & FITTINGS.

CROWN TUBE-WORKS,

WEDNESBURY, STAFFORDSHIRE.

WAREHOUSE: SOUTHWARK STREET, LONDON.

JAMES RUSSELL & SONS, LIMITED,

PATENTEES & FIRST MAKERS OF WROUGHT-IRON TUBES,

ONLY MAKERS OF HOMOGENEOUS METAL TUBES.

MANUFACTURERS OF

TUBES and FITTINGS for GAS, STEAM, and WATER;

LAP-WELDED, LOCOMOTIVE, MARINE, and other BOILER TUBES;

HYDRAULIC TUBES, BEDSTEAD TUBES, WELL TUBES, TELEGRAPH POSTS, COILS, &c.;

GAS-FITTERS TOOLS, VALVES, COCKS, &c.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM.

MANUFACTURERS OF

TELESCOPIC & SINGLE GASHOLDERS,

CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

SOLE MANUFACTURERS OF LIVESEY'S PATENT GASHOLDER MAN-LID,

By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

ROOFS, GIRDERS, BRIDGES, AND BOILERS OF ALL KINDS.

Drawings, Specifications, and Estimates supplied on application.

London Agent: W. G. DAVIS, 2, BRABANT COURT, PHILPOT LANE, E.C.

THE LANCASHIRE GAS-METER COMPANY,

LIMITED,

FALCON METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET & DRY GAS-METERS, GOVERNORS, PRESSURE & EXHAUST REGISTERS,

&c., &c.

STREET-LAMP METERS in CAST-IRON CASES.

LAMP COCKS AND BRASS FINISHING IN ALL ITS BRANCHES.

JOHN WRIGHT AND CO., ESSEX WORKS, BIRMINGHAM,

Beg to call the attention of MANAGERS and DIRECTORS of GAS COMPANIES to the following letter which they have lately received.

COPY OF LETTER RECEIVED FROM MAGNUS OHREN, Esq.

To Messrs. John Wright and Co., Essex Works, Birmingham. *Crystal Palace District Gas Company, Lower Sydenham, S.E.*

Dear Sirs,—In reply to your inquiries, I am glad to state that the use of GAS COOKING AND HEATING STOVES has been a complete success here. We have several hundred in use in our districts. We also find it advantageous to let out Stoves at a small rental. We have now 275 Stoves at rent.

The Stoves you make I can with confidence recommend, having so many in use, and giving satisfaction. I need scarcely point out to you the advantage to Gas Companies to recommend the use of Gas Stoves to their Gas Consumers, even where they do not supply them on sale or rent, as the use of Gas Stoves brings day consumption, and thus the Company make a profit by day as well as by night.—I am, dear sirs, yours faithfully, MAGNUS OHREN.

Size, 25½ in. high; 14 in. wide; 12½ in. back to front.

Price 50s., complete with Pan and Gridiron.

GAS HEATING STOVES

(TERRA COTTA AND IRON).

THE CHEERFUL STOVE.

COOKING STOVES.

BREAKFAST COOKERS.

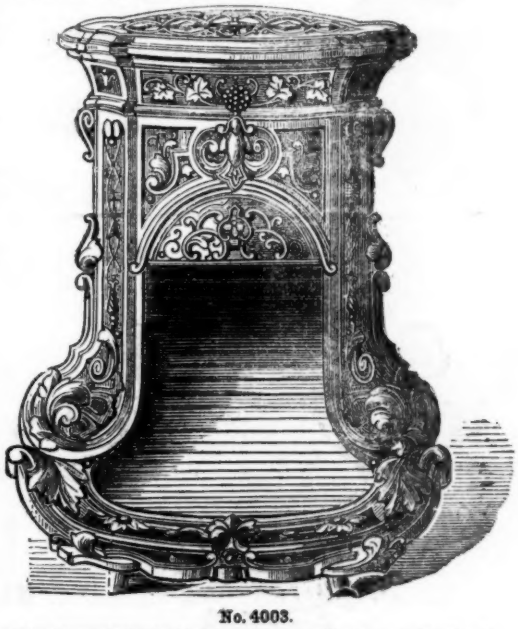
BATHS HEATED by GAS

GAS STOVES

For Boiling, Broiling, Preserving, Heating Flat Irons, and for all other Domestic Purposes.

Gas Companies and the Trade who have not our Illustrated Catalogue are respectfully requested to apply for same.

A LIBERAL DISCOUNT to the TRADE.



No. 4003.

THE CHEERFUL GAS STOVE, with Copper Reflector,

Has all the appearance of a Bright Fire.

PRICE from 32s.

THE

IMPERIAL METER COMPANY,

LIMITED,

KING'S ROAD, LONDON, N.W.,

OFFICE: 115, VICTORIA STREET, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

TO GAS COMPANIES, ENGINEERS, &c.

These Works are in full operation, and it will be the aim of the New Company not only to keep up the excellent workmanship of their predecessors, but, by the introduction of special machinery, to manufacture **Meters of a higher standard than is usually given, without increasing the cost.**

Special attention is invited to the Compensating Wet Gas-Meter of De Castro and Burton, which is now becoming so generally adopted, and is more simple in construction than any other Compensating or Ordinary Wet Meter. There is but one centre of friction to be overcome by the gas. By its self-adjusting principle it maintains an unvarying water-line; and the reservoir contains sufficient water to supply the Meter for twelve months without attention. It is unaffected by "tilting," and cannot be "flooded" by any pressure.

The Company also manufacture Dry Meters upon the most improved principle, and all their Meters being made to standard gauges, the most accurate measurement is obtained.

Attention is also called to their Dry Meters in Wood Cases, as used by some of the London Gas Companies. These Cases are a great preservation to Tin-plate Meters, especially in seaport towns, where the air is impregnated with salt; they are also particularly suited for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

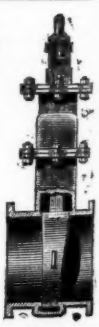
JOSEPH AIRD,

WELLINGTON TUBE-WORKS, TIPTON, STAFFORDSHIRE,

MANUFACTURER OF

EVERY DESCRIPTION OF TUBING, GAS, STEAM, HYDRAULIC TUBES AND FITTINGS,
EITHER BLACK, GALVANIZED, OR ENAMELLED HOT WATER TUBES AND FITTINGS,
CORE BARS, COILS, COCKS (IRON OR BRASS),
CHANDELIERS, &c., GAS-FITTERS' TOOLS, GAS TONGS, STOCKS, TAPS, DIES, &c., &c.,
HANDRAIL TUBINGS, IRON AND BRASS, PLAIN OR TWISTED,
TELEGRAPH TUBES OR POLES, &c., &c.

C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

MIDLAND IRON-WORKS,

DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

Established

1795.

JOSEPH CLIFF & SON,

THE ORIGINAL

WORTLEY FIRE-BRICK WORKS,

NEAR LEEDS,

MANUFACTURERS OF ALL DESCRIPTIONS OF

FIRE GOODS, and Salt-Glazed Drain-Pipes.

LONDON WHARF:

Wharf No. 4, inside Great Northern Goods Station, King's Cross, N.;

LIVERPOOL—1, Back Leeds Street,

Where is always kept a Stock of Retorts, Fire-Bricks, Terra Cotta Ware, and Drain-Pipes.

WILLIAM SUGG,

GAS ENGINEER,

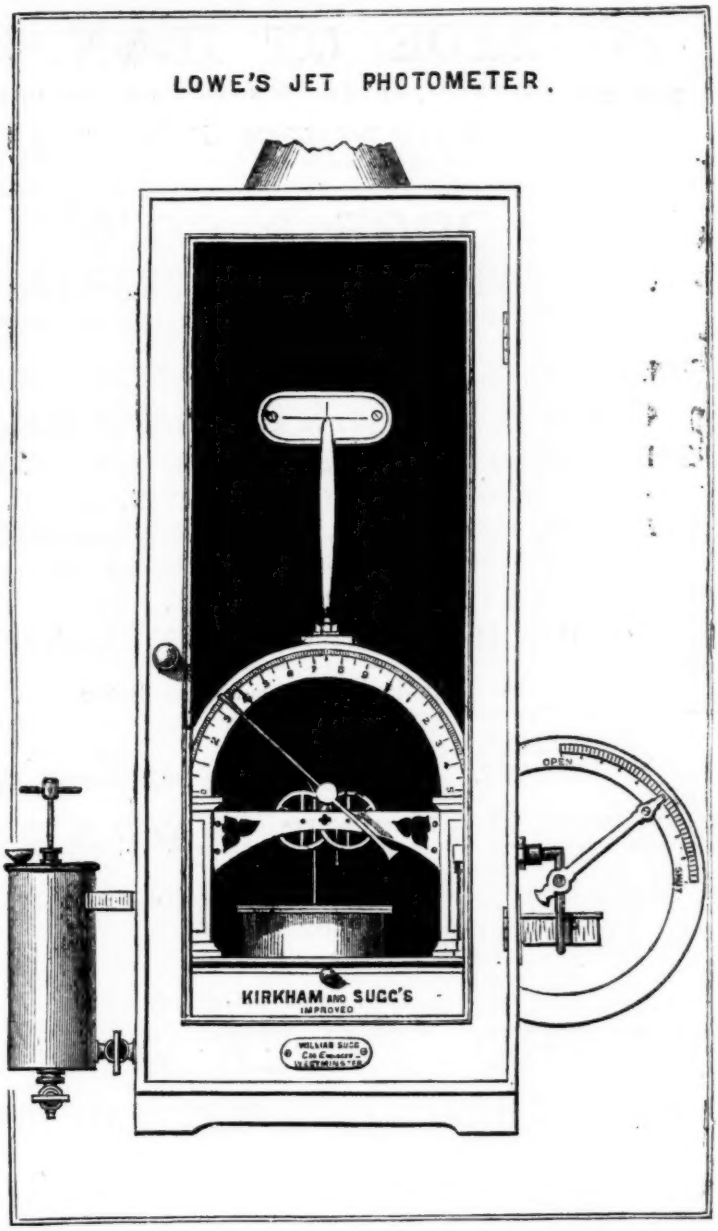
VINCENT WORKS, VINCENT STREET,

WESTMINSTER, S.W.

"EVANS"

Photometers,

which do not require a Dark Room, with every Fitting accurately made to Gauge, French Polished Bench and Drawers complete, as approved by the Gas Referees.



"LETHEBY"

Photometers,

with Fittings and Bench complete for Dark Room, as approved by the Gas Referees.

LOWE'S JET PHOTOMETER

(KIRKHAM AND SUGG'S IMPROVEMENTS),

With new external Water-Line Regulator; Improved Micrometer, with Quadrant divided into 45 degrees; Valve, with *pro ratâ* opening; Improved Ventilator, Purple Glass Height of Flame Measurer; King's Gauge, working on Friction Rollers. In French Polished Pine Case. Diagram for ditto for finding the Illuminating Power in Candles.

PRICE £12 10s. COMPLETE.

Can also be had with additional Scale on Pressure Gauge, to show by inspection the Illuminating Power in Sperm Candles, at a slight extra cost.

NOTE.—When an order is given for a Jet Photometer with this latter addition, it will be necessary to state about the quality of Gas for which it will be used. The range in candles will not be more than three or four.

PRICE LISTS WILL BE FORWARDED POST FREE ON APPLICATION.

GAS PURIFICATION & CHEMICAL Co., LIMITED.

(Successors to JOHN WILLIAM O'NEILL & CO.,)

Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,

CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON, } Joint Managing Directors.

HODGE & CO.'S

IMPROVED VENTILATING SUN-LIGHTS

WITH TALC REFLECTORS AND SELF-ACTING VALVES TO PREVENT DOWN-DRAUGHT;

VENTILATING GLOBE LIGHTS for DINING-ROOMS, LIBRARIES, &c.

Ormolu, Bronze, & Crystal Gaseliers;

MEDIÆVAL CHURCH WORK AND CORONÆ

COCKS, VALVES, and FITTINGS for GAS, STEAM, and WATER;

COLUMNS, BRACKETS, & STREET LANTERNS;

BLACK AND GALVANIZED BARREL COMPO AND TIN PIPE.

GAS ENGINEERS,

100, HATTON GARDEN, LONDON.

Drawings and Prices upon application.

BATES'S PATENT. No. 660. FEBRUARY, 1875.

BATES'S PATENT APPARATUS

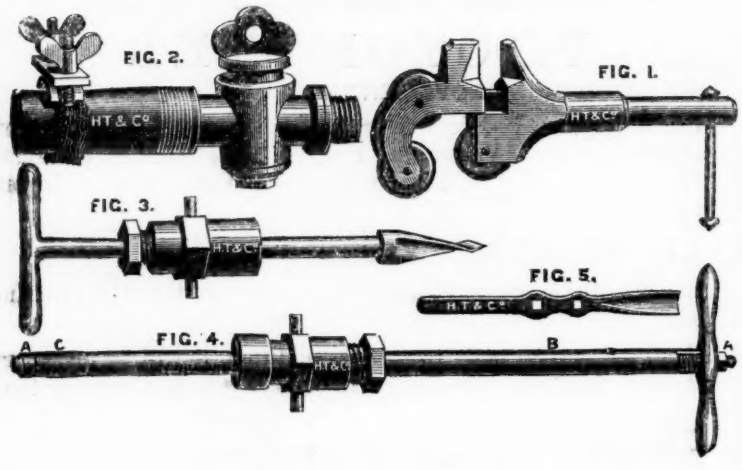
For Attaching Main Cocks, Valves, or other Connexions, to Service-Pipes when under Pressure.

Sole Makers and Licensees:

HAYWARD TYLER AND CO.,

HYDRAULIC AND GENERAL ENGINEERS AND BRASSFOUNDERS,

84 & 85, UPPER WHITECROSS STREET, LONDON.



PRICES.

Set of Tools for making Attachments to ¾-inch Lead Services	£3 0 0
Plug and Stuffing Box for ⅝-inch Service extra . .	0 10 0
Plug and Stuffing Box for ½-inch Service extra . .	0 10 0
Complete Set for the 3 Sizes.	4 0 0

The Prices Quoted comprise the whole Set of Tools, by the aid of which the patent process is rendered so simple that any plumber can work it after having it once explained, or reading the printed instructions. The tools are light and handy, and no trouble to carry about.

The Joints can be made in any of the ordinary ways.

TANGYE BROTHERS AND HOLMAN,

LAURENCE POUNTNEY LANE, LONDON, E.C.,

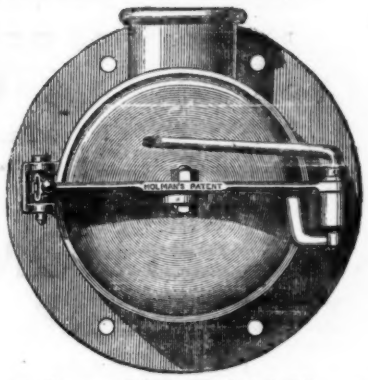
SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH

HOLMAN'S NEW PATENT BRACKETED CROSS-BARS,

Anti-Friction Catches and Eccentric Fastenings.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required. Holman's New Self-Sustaining Cross-Bar ensures freedom of joint and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested (rigid cast iron is now successfully employed), nearly 20,000 being in use at various Gas-Works in London and the Provinces, among which may be mentioned:—

The Gaslight Co., Beckton (where, by the end of 1875, nearly 4000 were in use).
" Gaslight Co., Bow Common.
" Gaslight Co., Silvertown.
" Gaslight Co., Lupus Street.
" London Gaslight Co.
" Independent do.
" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

The Gas-Works, Royal Arsenal, [Woolwich.
" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
" Manchester Corporation do.
" Salford do. do.
" Rochdale do. do.
" Liverpool Gas-Works.
" Birmingham do.
" Birkenhead do.
" Nottingham do.

The Newcastle-on-Tyne Gas-Works.
" Lurgan do.
" Carmarthen Gas-Works.
" Merthyr Tydfil do.
" Windsor do.
" Leeds do.
" St. Albans do.
" Over Darwen do.
" Rotherham do.
" Aylesbury do.
" Bournemouth do.
" Ystrad do.
" Cardiff do.
" Rochester do.

The Keighley Gas-Works.
" Aberdare do.
" Ballymena do.
" Richmond do.
" Stalybridge do.
" Longton do.
" Exeter do.
" Ross do.
" Falmouth do.
" Barrow-in-Furness do.
" Belfast do.
" Wakefield do.
And other Provincial and Foreign Gas-Works.

IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them.

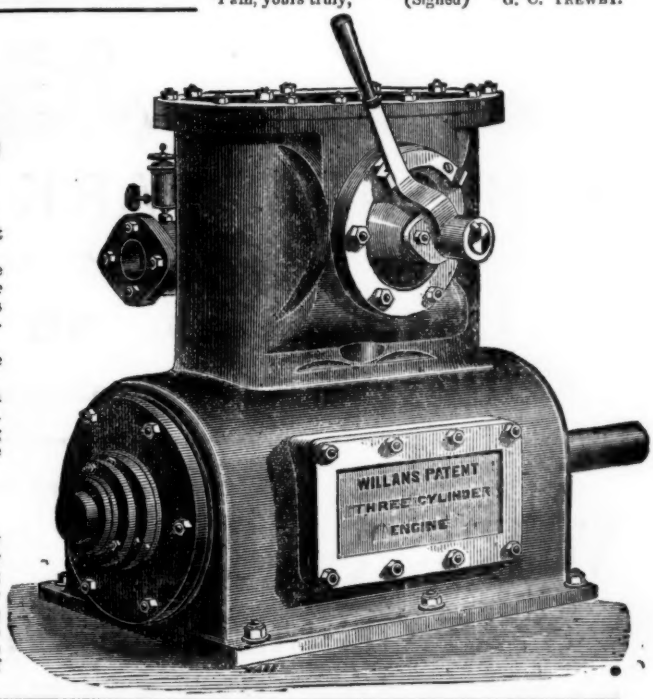
I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly, (Signed) G. C. TREWBY.

WILLAN'S PATENT THREE-CYLINDER ENGINE,

ESPECIALLY SUITED TO DRIVE

GAS-EXHAUSTERS.



This Engine is exceedingly simple in construction, unlikely to get out of order, and can be safely driven by the most unskilful.

No fly-wheel is necessary, there being no "dead centre." The connecting-rods being always in compression, there is no blow on the crank-pin at either end of the stroke, and consequently the Engine is free from the knocking which is nearly always present where double-acting cylinders are used.

All the working parts, being contained in the cylinder casing, are thoroughly protected from injury by dust, &c.

The Engine occupies very much less space than is taken up by an ordinary engine doing equal work; it is also of considerably less weight.

The foundations required for it are of the simplest kind. Driving gear can be attached to either end of the crank-shaft, so that the Engine may at will be made either right or left hand.

From the "Engineer," Oct. 1, 1875.

"Although the engine is only single acting, it will do considerably more work than an ordinary double-acting engine of the same cylinder capacity. There is no thump, no matter how loose the bearings are; indeed, the whole of the bearings may be quite worn out before the working of the engine is affected. It is perfectly noiseless, and the speed at which it can be driven is very great. The working parts can be examined at a moment's notice, by removing the door at the side of the casing. These parts are very few in number, and are of the simplest description."

INDICATED HORSE POWER—At a mean steam pressure of 30 lb. per square inch.	2½ H. P.	4½ H. P.	13 H. P.	16 H. P.	31 H. P.	53 H. P.
Diameter of Cylinder . . . . . inches.	3	4	6	7	8	10
Length from end to end of shaft-bearings . . . . . "	18	25	36	47	49	60
Breadth . . . . . "	12	15	20	22	27	34
Height . . . . . "	19	20	29	40	42	56
Weight of Engine complete. . . . . cwt.	2½	3½	8	9	16¼	31
Diameter of steam-pipe . . . . . inches.	¾	1	1¼	1½	2	2½
Price complete, with Reversing Gear	£25	£35	£55	£80	£110	£180
If fitted with Tangye's Patent Governor . . . . . EXTRA.	£6	£7 10	£9 10	£10	£12 10	£14 10

London 1851. New York, 1853 Paris, 1855. London, 1862.

Dublin, 1865

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

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THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

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3rd, Incur no loss of Gas by evaporation;
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8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

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WET & DRY GAS-METERS,

STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

AND EXPERIMENTAL APPARATUS,

STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

METERS FOR MEASURING WATER.

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THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 2, 1876.

Circular to Gas Companies.

As the ninth of this month approaches, we naturally feel some anxiety as to the fate of the Regulations Bill, which is down for a second reading on that day. Until we see the paper of business for the evening, it is, of course, impossible to form an estimate of the chance the Bill has of being proceeded with at all; but, after so long a notice, we may assume that it will have a good place on the paper, and that, in the absence of some important Government measure before it, we may have a debate and division, if not prevented by a "count out."

More than the fate of the Regulations Bill may be said to depend on what is done on this day week. If that measure be defeated, it cannot be supposed that the South Metropolitan Company will proceed with their Bill; and, although the Chartered Company are, in a measure, pledged to go on with the Bill they accept, rather than promote, the defeat of, what we may call, the parent Bill might induce them to endeavour to obtain some modification of the terms which their Bill, as now before the House, would impose. We cannot imagine that the company willingly accepted the auction clauses, and have no doubt they would seize any opportunity of getting rid of them. Such a chance may present itself, if the Regulations Bill should be defeated, or even if it should be referred to another committee. We think it quite possible that Mr. Livesey might be as successful in opposition to auction clauses, as he was in support of the sliding scale.

The Camberwell Vestry, our readers will see, have agreed to spend the enormous sum of £300 in opposing the Bill of the South Metropolitan Gas Company. Their representative on the Metropolitan Board of Works might have explained that, large as that sum may appear in Camberwell, it will not go far in a Parliamentary contest. We hope, however, that the Vestry will get as much as they can for their money, although we believe that their object is perfectly unreasonable. Among several other things, the Bill is to provide power to amalgamate, and the desire of the Vestry is to fix the South Metropolitan Company to a maximum price of 3s. per 1000 feet of fourteen-candle gas under all circumstances. Now, it seems to have been settled that the standard of illuminating power in London shall, for the future, be sixteen candles, and in the first place the Vestry must make some allowance for the difference. Then we, for our own part, entertain some doubt, whether the South Metropolitan Company can, for many years, go on supplying fourteen-candle gas for 3s., even if they stood alone. Events seem to have shown that they have reached a minimum price, and a rise in the cost of coal, which we fervently hope will soon take place, would compel an advance in the price of gas. If a southern amalgamation should be formed—and we believe it must be sooner or later—the consumers in Camberwell may be content to share the lot of those in Shoreditch, and pay a higher price for their gas. Of this they may be certain, that a Parliamentary Committee will impose no exceptional legislation in deference to the views of an individual parish. The Camberwell Vestry had better keep their £300, and devote the money to some useful purpose. All they are likely to gain by the expenditure of that sum in opposition, can be secured by the presentation of a simple petition.

But our readers will see that the Vestry of Camberwell discussed other matters, besides a limitation of price, in the case of the South Metropolitan Company. Gas bills are a mystery, but not more so, we may say, than other bills; for we constantly hear people protest, that they have never had all the loaves of bread the baker has charged for, nor all the joints of meat the butcher has put down in his account. Gas and viands consumed are quickly forgotten; and, when the inevitable bill comes in, people are astonished to find how much they have eaten and burned. Complaints, such as those made at the Camberwell Vestry, are, as our readers know, common all over the country—where gas is furnished by local authorities, as well as in places supplied by companies. All these complaints arise from a general ignorance of the construction of that simple and beautiful machine, the gas-meter, which is as perfect an instrument as a watch or a clock. We have to apologize to our readers for entering on these details, but it is sometimes obligatory on our part, to meet popular views. The motive power in a watch is a spring; in a gas-meter, it is the pressure of the gas. A meter, like a watch, may be "fast" or "slow," but only within narrow limits. If a consumer considers his meter to register "fast," he has only to send notice to the company, and have it disconnected and tested. We believe we are perfectly right in asserting, that gas companies very rarely remove meters on the suspicion that they register "slow." Too little attention is, in our opinion, paid to this matter, and we have continually advocated the frequent overhauling of meters, which ought never to be left more than three or four years without examination.

The statements of the chairman of the Camberwell Vestry cannot be passed over. He asserted that no change of price made any difference in his bills, and that if he consumed no gas at all the quarterly account was exactly the same. Of course, we cannot impute untruthfulness to the Chairman of a Vestry, therefore, we feel bound to call upon the Chartered Company—for it is they who are implicated—to make a rigid investigation of the case. Mr. Turney alleges that he burnt no gas at all in his City establishment, but that, nevertheless, his gas account was the same as when he burnt gas. We are ignorant of Mr. Turney's City address, but he must be under the Chartered Company, and we demand, in the interest of all gas companies, that the truth of his statements shall be inquired into. If he be, as we must assume, a truthful man, he will, of course, refuse to pay his gas bill, and make the company prove the consumption. But he may have bad fittings, only in that case there should always have been a stink of gas in his warehouse. The allegation, however, must not remain unanswered. It is either a gross libel, or reveals a gross wrong, and the matter cannot rest without explanation.

An ingenious mode of accounting for the seemingly inexplicable phenomena must not be passed over. Gas engineers, by an inexorable law, produce in their manufacture a mixture of non-luminiferous gases, and highly luminiferous gases and vapours, and these pass through the meter together. It must be remembered, however, that the illuminating power of these mixtures is tested by examiners, totally independent of the gas companies—appointed, indeed, by the Metropolitan Board of Works. Their returns may, we believe, be taken to fairly represent the quality of the gas supplied. If, however, it be insinuated that gas managers can, at their will, vary the proportion of light-giving and non-light-giving gases, so that the mixture may cause an exaggeration of the consumers bills, that we expressly deny. Gas is now manufactured on such a large scale that "tricks" are impossible. Retorts are charged and discharged with the regularity of clock-work, and any tampering with the quality of the gas is out of the question. We must ask pardon of most of our readers for noticing this matter, but a reference to the discussion at the Camberwell Vestry, which we report in another column, will show that our remarks are not uncalled for.

Returning for but a brief space to the paper of Mr. H. Chubb, reported in our last issue, we have to confess to some difficulty in following him over all his ground. He obviously objects to the Regulations Bill, which his company have accepted with something more; and where is the use of our remonstrance? In his strong official position, and with his great reputation, it might have been thought that he could have successfully contended against the

influences which have led to the acceptance of, what we regard as, the calamitous terms involved in the Regulations Bill and the auction clauses. Of the latter we do not care to say more than to repeat an opinion that they are eminently unjust to existing shareholders; as to the sliding-scale and Regulations Bill, we may express a confident belief that they will not survive another coal famine. Before that occurs, however, the Metropolitan Gas Companies may have ceased to exist. Mr. Chubb says plainly, as we have always said, that whenever the Metropolitan authority or authorities, however they or it may be constituted, offer fair terms for the gas undertakings, these must go, and private enterprise, so far, come to an end. It will, we anticipate, be several years before any authority is constituted who may be safely entrusted with the supply of gas and water. Before that time comes, much trouble may be in store for Metropolian Gas Gompanies if the Regulations Bill should pass. But we are forgetful. The Chartered Company will be independent of the Regulations Bill, and thus it is possible that the present confusion in metropolitan gas legislation may be made worse confounded.

We are tempted to say a few words on the future of gas companies, as it may be affected by the supply of the working classes. Candidly speaking, we do not think that the working classes will at present be greatly benefited by a supply of gas. No doubt the Table of Mr. Glover, as given by Mr. Chubb, expresses a truth, but not the whole truth. Light is most useful, if placed where it is wanted, and the misfortune of gas is, that the source of light is to a great extent immobile. If we take a working man's sitting-room, and imagine a bracket over the mantel-shelf, or a pendant from the ceiling in the middle of the room, we see at once how insufficient the light is, however good it may be. It is not where it is wanted. The tallow dip and the petroleum lamp can be placed anywhere, and the wife may darn, and the husband may peruse his *Echo*, by the aid of the light, without trouble. But a gaslight overhead always offers a difficulty. If you wish to read by it, your head is sure to be in the way. What is it we constantly see in middle-class drawing-rooms? There is a gaselier with, it may be, four or six jets, depending from the ceiling, which ought to afford sufficient light for the whole room; but expensive pains have been taken, by the use of opaque globes, &c., to cut off seventy or eighty per cent. of the light given by the gas, and, consequently, we find four or six candles burning on the chimney-piece, a moderator or duplex lamp on the table, and two candles at the piano. Gas is condemned as useless, because the light is not where it is wanted, and valueless, because express pains are taken to destroy the light it is capable of affording. We have, it may be said, all over the kingdom, excellent gas, but we do not know how to use it. The gas manufacturer has done his part; the gas-fitter has now to do his. We offer no suggestions, but shall return to the subject at a future time, and can only to-day express a candid opinion that lamps and candles will hold their own against gas in the houses of the working classes.

A question arose, in the course of the discussion, as to whether or not a ten per cent. dividend was guaranteed to the gas companies. In our opinion, it was not until the Acts of 1868-9 were passed, containing the revision clauses, that a distinct guarantee was given. The Act of 1860 gave a range of price, which was, no doubt, considered sufficient for a maximum dividend; but, most certainly, it did not *guarantee* that dividend. The guarantee was the work of the authorities, who are now seeking to upset the arrangement they contended for in 1868-9.

Mr. Chubb was blamed by some for writing his paper exclusively from a monopolist's point of view; but we do not see how he could have done otherwise. The grievances of gas consumers are always before the public; but the gas companies rarely find a defender. If we found fault with the author on this score, it would be because we think his defence weak and tame. Much more, we believe, might have been said on behalf of the gas companies; and, at the present moment, an able defence of their interests would have been valuable.

The Exeter Town Council, as we have already told our readers, are very anxious to get possession of the gas undertaking, and seek to achieve their object by a continual persecution of the company. Their present purpose is to make out that the works are a nuisance, and to put the company to great expense, in order to depreciate the value of the property, if, sick of the contest, the company consent to sell. Possibly, the result of the proceedings we report elsewhere, will encourage the company to resist. Exeter, or a part of it, seems to be as full of "nuisances" as Bow Common or Belvedere, with some additions in the shape of sewers discharging into the river. No doubt, there is, at times, an intolerable stench pervading certain parts of Exeter; but the attempt to fix the production of it entirely on the gas company signally failed. It was clearly proved, that the works are conducted with every precaution to avoid offence. That sulphuretted hydrogen may be occasionally detected in the best regulated works, we do not deny; but the process of purification followed at Exeter precludes the possibility of the air being contaminated by the worst of all nuisances in gas-works—sulphuretted lime. Oxide is used before the lime, and hence only carbonate of lime is removed from the purifiers. Dr. Redwood's theory, advanced on a former occasion, that coke was quenched with ammoniacal liquor, is proved to be untrue. We know very well, that when coke is quenched with simple water, some sulphuretted hydrogen is produced, with a good deal of steam; there can be no doubt that the "bluish vapours," observed, and deposed to by the witnesses for the prosecution, resulted from this operation.

It is worthy of remark, that the Town Council did not, on this occasion produce any expert evidence. On the part of the company, witnesses were called whose testimony could not be impeached, and the result was a dismissal of the case, after a very short consultation among the magistrates. Nothing daunted, however, it would seem that the officers of the Corporation paid another visit to the works, and made what they consider to be a most important discovery. It would be very important, indeed, if what is alleged be the fact. The assertion is that the covers of the scrubbers are rotten, and that there is a continual escape of crude gas. We cannot for a moment believe the statement. Any defect of this kind must involve such a serious loss to the company, that it would have been immediately discovered and rectified if it had ever existed.

That admirably-managed undertaking, the Plymouth Gas Company, continues in a most prosperous state. The accounts for the past year are so satisfactory, that the directors are able to announce a reduction of price from 3s. to 2s. 6d. per 1000 feet, and in the case of public lights from £3 10s. to £3. Notwithstanding these reductions, which constitute a gain of at least £6000 per annum to the consumers and ratepayers in the district, the directors are confident of being able to pay maximum dividends for the current year. We have here the case of a company—not a single one—who faithfully fulfil their duty to the consumer without the bribe of a sliding scale. The prescribed illuminating power of the company's gas is, we believe, twelve candles, but they supply, on the average, fourteen-candle gas, tested by the Sugg-Letheby burner.

We give, in another place, so much of Mr. Crookes's lecture, "On the Mechanical Action of Light," as relates to the application of his wonderful discovery to the photometric valuation of gas. We are incapable of expressing any opinion as to whether Mr. Crookes has advanced a true explanation of the phenomena described. We leave professed physicists to settle that question. Knowing, however, the extraordinary skill with which Mr. Crookes's experiments are conducted, we can hardly conceive the possibility of the discovery of any source of error which he has not anticipated. It will readily be seen that, whatever may be the future of Mr. Crookes's photometer, it is not at present a practical instrument. That it may be made such we have little doubt, and we shall wait with some curiosity for further developments. We had last week to defend the use of candles in photometry. Mr. Crookes condemns their use in one sentence, and in another clearly shows that they may be relied upon. "Standard candles," he says in one place, "are the most variable things in the world. "They never burn with the same luminosity from one hour to "another, and no two candles are alike." But subsequently we read as follows:—"When exposed to different numbers of "candles, at the same distance off, the speed of revolution in "a given time is in proportion to the number of candles—"two candles giving twice the rapidity of one candle, and three, "three times, &c." We accept this latter statement as a proof that the much-abused candle is, after all, as tested by the most sensitive means known, a much better standard of comparison than is commonly believed.

We can only devote a few words to the report of the directors of the New Gas Company, which, we are rather astonished to learn, is still in existence. A much further prolongation, however, can hardly be expected, for the directors state "that they "have, for many months, been working under very discouraging "circumstances, having had to advance their own money, and "become security for the company's debts." We believe this state of affairs has been paralleled in the history of some now successful gas undertakings; but, we fear, there is no hope for the "New Gas Company." The directors say that the works produce a good profit; but we look to the accounts, and can only discover extensive losses. The balance-sheet, signed by Messrs. Quilter and Ball, is a caution. The company seem to have received cash to the amount of £96,805, which, after paying £50,000 for patents, left the directors some £46,000 with which to commence action. That sum, and much more, seems to have been entirely lost. It would appear impossible that the company can go on much longer, and thus will disappear one more of the many enterprises designed to revolutionize the art of gas-making.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

XCIII.

Designs for Small Works.

The engravings on the next page represent the elevation and plan of gas-works, capable of producing 50 million feet per annum, or a maximum make of 250,000 feet per diem, constructed for supplying a continental manufacturing town, and although erected nearly thirty years ago, are well designed and worthy of imitation, except as regards the extent of the site, which is by far too limited. The works are situated at some distance from water communication, so that all the coal has to be carted into the premises.

The history of the company owning these works was similar to that of many other gas establishments, for, during the first six years of their existence, instead of realizing profits, a positive loss of some thousands of pounds was incurred. This arose from several causes, the most prominent of these being the exorbitant prices charged for services and meters, and the very impure state of the gas supplied. Thus besides the high price of gas, which was about 11s. per 1000 feet, a heavy tax had to be paid, in addition to the expense of the fittings, before a shop could be supplied with this means of illumination. But by the company adopting a more liberal policy, and seeking a continuous permanent advantage from the sale of gas and coke, rather than a single profit from the meters and services, and also improving the quality of their gas, the public eagerly availed themselves of the advantages of gas lighting, so that the establishment, which at one period was considered to be preposterously large, in the course of eight or nine years was found to be insufficient for their requirements, and other land had to be procured to admit of the necessary augmentations to meet the demands upon the company.

The establishment in question consists of a retort-house, 80 feet long and 55 feet wide, having 16 benches of single retorts, with a passage in the centre, which by some engineers may be considered objectionable, on account of the loss of space that might be occupied by the retort-beds. In this case, however, the form and position of the ground rendered it imperative. The coal-store is capable of containing about 600 tons. The condenser is formed by 72 12-inch pipes, with top and bottom boxes. The scrubber is 30 feet high and 6 feet in diameter, provided with the liquid distributor. The purifiers are four in number, each 12 feet square internal dimensions, having five tiers of wooden grids. The connexions are 12-inch, controlled by a central slide or dry valve. A suitable apparatus raises the covers of the purifiers.

The shaft is octagonal, 60 feet high, with a clear opening of 10 square feet area.

The boilers, engines, exhausters, and pumps are in duplicate, so that, in the event of an accident occurring to one of the apparatus, the other is in reserve. The liquor and tar tanks are both underground. The lime-shed is of ample capacity, but afterwards, when oxide of iron was employed, the want of a suitable space for its revivification was recognized. As in many continental works, the meter and governor are placed in a separate building, surpassing in ornamentation the rest of the work. The gasholders are each 80 feet in diameter, and 24 feet deep, containing 120,000 feet; and were so arranged as to be rendered telescopic, which was subsequently carried into effect. The tanks are of stone, this being the building material of the locality. The offices of the works (distinct from those of the town), together with the residence of the manager, laboratory, general stores, and porter's lodge, are all represented; and, as the works were evidently designed to suit the limited locality, perhaps a better arrangement could hardly be made.

Having at our command the estimate, furnished by a firm of great respectability, for the material forming the apparatus for works of this magnitude—the holders, however, having cast-iron tanks—we present it to the reader, observing, at the same time, that tanks of cast-iron, on the average, cost about double the price of those in masonry.

Estimate.

Two gasholders, each capable of containing 120,000 cubic feet, constructed in such a manner that they may be hereafter rendered telescopic, with cast-iron tanks, columns, girders, counter-balance weights, chains, chairs, connexions, and valves, all complete, at £4600 each	£9,200	0	0
Eighty clay retorts, with their corresponding settings, mouthpieces, lids, and fittings, ascension and dip pipes, hydraulic main, furnace doors, bars, buckstaves, &c., all complete, at £17 10s. each	1,400	0	0
Condenser of 72 12-inch pipes, with top and bottom boxes, complete	295	0	0
Four dry lime purifiers, each 12 feet square, with connexions and lifting apparatus as described	620	0	0
Scrubber, 30 feet high and 6 feet in diameter	230	0	0
Two engines and exhausters	250	0	0
Two boilers, and setting	110	0	0
Station-meter	150	0	0
Governor	60	0	0
Iron roof for retort-house	310	0	0
Slating same	88	0	0
Pipes, valves, and connexions on works	187	0	0
Weigh-bridge	70	0	0
Barrows, tools, rakes, &c.	45	0	0
Total	£13,015	0	0

The whole delivered free on board, or at a railway station, for the price stated.

In a work of this capacity, assuming the production of gas to be 9500 feet per ton of coal carbonized, about 5300 tons of coal would be required annually. From this would be obtained 50 million feet of gas, and 3500 tons, or 5300 chaldrons, of coke, of which 30 per cent. would be required for carbonizing, leaving 2450 tons, or abont 3600 chaldrons, of coke for sale. To this must be added about 50,000 gallons of tar, the value of which will depend on circumstances. The lowest estimate, however, that can be placed on this residual, even when employed for heating the furnaces, is 1½d. per gallon.

Finally, when such works are situated in a locality favourable for the manufacture of the ammoniacal liquor, about 2s. per ton of coal carbonized should be realized therefrom; but when the liquor is sold in its crude state, not more than one-half of that return can be expected.

These are results which, in all ordinary works of medium capacity employing Newcastle coals, should be obtained; and although the production of gas may be improved, it will only be attained at the expense of its illuminating power. The fuel account may also, by intelligent working, be rendered more favourable; and whenever any material deviation from the stated results, to the prejudice of the company, exists, it can only be attributed to bad management, whether this arises from imperfect settings of retorts, or insufficient heat for carbonizing, or the carelessness of the men in charge, who, neglecting the dampers of the furnaces, permit the coke to pass uselessly in its gaseous state to the atmosphere, or whether it may arise from leakage in the retorts, holders, or other parts of the works, or the use of wet coal, or from whatever other cause, there is still the fact of bad management, and the sooner the remedy is sought to counteract the evil, the more profitable it will be for the company, and the more creditable for the manager concerned. It is necessary to state that, in making these assertions, we confine ourselves to the every-day practical workings of establishments such as those under consideration; which results, with ordinary care and supervision, can be easily realized under like conditions as to quality of coal carbonized and the size of the works, and although in several establishments the "workings" are superior to those mentioned, they cannot be accepted as a fair criterion.

But it has frequently occurred that the advantages of a high production of gas have been counteracted by excessive leakage, and probably a defective station-meter has given a wrong estimate of the one and the other. On the other hand, we have heard of overzealous and unscrupulous foremen, who have overcharged the meter during their "shift," in order to show a large production and their superior working. All station-meters should be constructed so as to prevent this.

The sale of coke will be largely influenced by the care in its delivery. Within our memory, a certain metropolitan work could always command a much higher price per chaldron than neighbouring establishments, which arose from carelessness in permitting the dealers to furnish sacks of extravagant capacity, consequently, the reputed chaldron was often 30 or 40 per cent. in excess of the real measure, leaving a large margin for increased price.

(To be continued.)

Reductions in the Price of Gas.—The directors of the Plymouth and Stonehouse Gas Company have reduced the price of gas to private consumers from 3s. to 2s. 6d. per 1000 cubic feet, and the charge for the public lamps from £3 10s. to £3 each per annum, the reductions to take effect from the 31st ult. At Leighton Buzzard from the same date, the price has been reduced from 5s. 5d. to 5s. per 1000. The Kingston-on-Thames Company give notice of a reduction of 4d. per 1000 feet from Midsummer next.

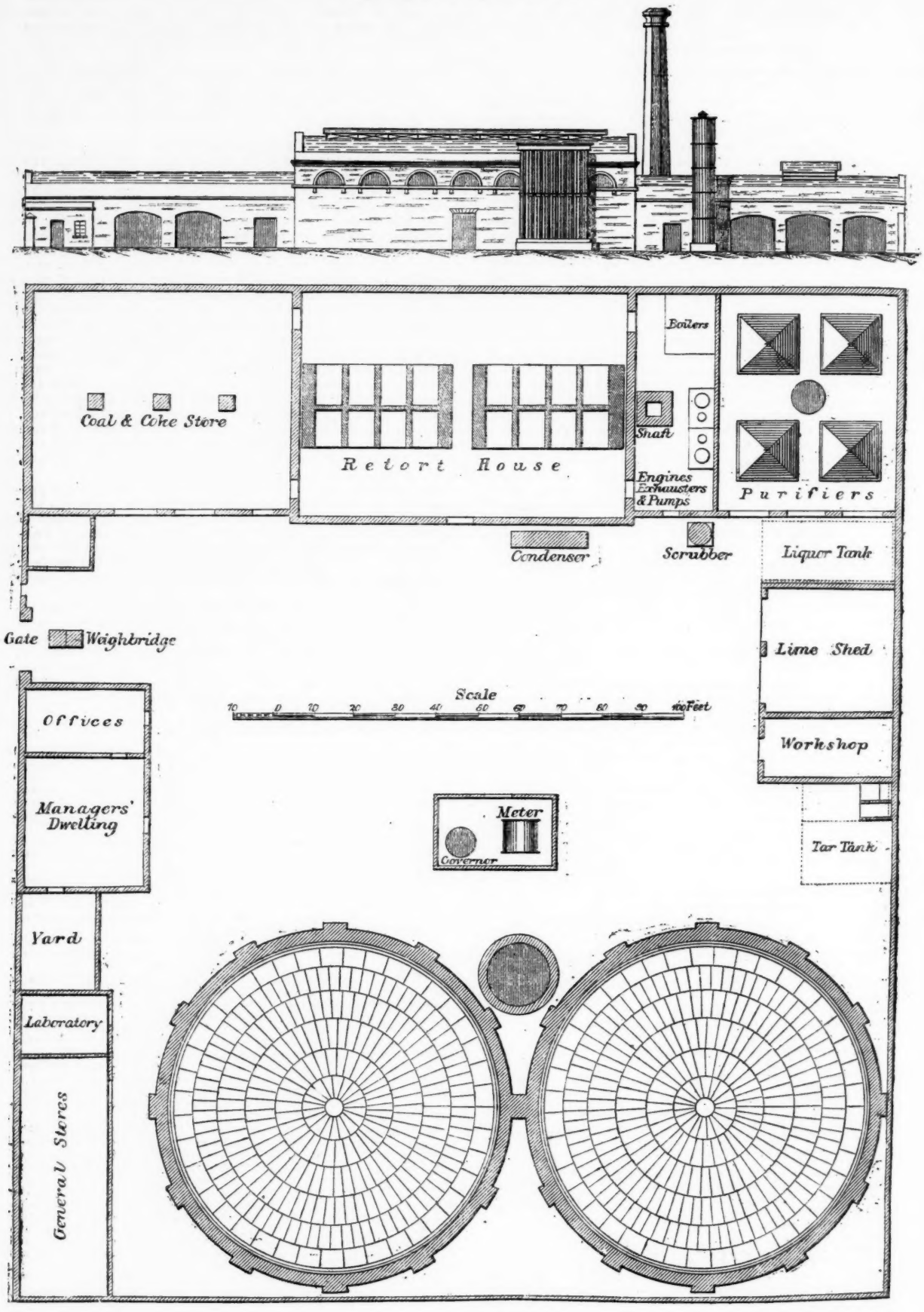
Important to Gas Companies Employes.—In the Bath County Court, on the 20th ult., Ambrose Hillard sued the Bath Gas Company for four days wages. He had worked as a stoker on Thursday, Friday, Saturday, and Sunday, and ought to have come to work on Monday morning at six o'clock, but he came half an hour late, and found his place as stoker filled up by another man. He was then told by the foreman to go labouring, but he refused to do this, and left. He sued for the wages for the days he had actually worked, but under the circumstances a nonsuit was entered with consent.

Malton Gas Supply.—At a meeting of the vestry of Malton, on the 20th ult., notice was received from the gas company of their intention to appeal against an increase of £20 in the new assessment of their gas-mains in the parish, upon the grounds that it was above the annual value, and not equitable compared with other property. The vestry determined to uphold the proposed increase, inasmuch as that since 1865 the company had been assessed on the same amount, whilst they had very greatly extended their mains in that time. The overseers also pointed out that there were 210 meters in the parish rented to consumers of gas at £20 per annum at the very least, and the vestry determined to test the question whether these were not legally as liable to be rated as any other rented property in the parish. [The local authorities of this parish do not seem to have heard of the decision in the Phœnix and Lee rating case, wherein it was decided by the Court of Queen's Bench that, on ascertaining the gross estimated rental of gas-works for assessment to the poor-rate, a deduction is to be allowed in respect of the cost of meters belonging to the company.]

Birmingham Water-Works Company.—On Wednesday last an extraordinary meeting of shareholders was held, when a report was presented, showing that the certificates in respect of the Corporation Water Annuities had been duly distributed, and that the sum of £3022 1s. 6d. cash, as provision for the conduct of the company's affairs subsequent to the 1st of January last, and for its ultimate winding up and dissolution, had been received. The directors asked for a vote of £1000 for the general expenses of the company, the costs incurred since the 1st of January last, and the costs of liquidation and winding up; for a vote of a sum of money to be distributed among officers and servants of the company, and for directions for the distribution of the balance of the £3022 1s. 6d. The chairman (Mr. G. Heaton) moved the adoption of the report, which was carried, and a vote of £1000 was agreed to, as recommended by the board. A further sum of £500 was voted to the solicitors of the company, in recognition of their services; and a third vote, apportioning the sum of £1000 to the directors, to be by them applied for the following purposes—namely, £200 to be specially appropriated to the chairman, and £800 to be divided rateably among the whole of the directors, in recognition of their zealous and able services; and the sum of £522 1s. 6d., being the balance of the £3022 1s. 6d., was voted to the directors, to be by them distributed among such of the other officers, servants, and agents of the company as they might select, and in such proportions and manner as they shall prescribe. A formal resolution was then passed to wind up the company voluntarily.

ELEVATION AND PLAN OF WORKS FOR PRODUCTION OF FIFTY MILLION FEET OF GAS PER ANNUM.

[*For Description, see preceding page.*]



FATAL ACCIDENT AT THE PORTSEA GAS OFFICE.—On Wednesday morning last, shortly before eight o'clock, a serious casualty occurred at the offices of the Portland Island Gaslight Company, now in course of erection in Commercial Road. The building is just rising above the ground, and over the cellars and rooms on the basement a concrete floor, about nine inches in thickness, is being laid. The flooring over the front cellar was completed during the previous week, and on Wednesday, it being considered that it had become sufficiently hardened to admit of the removal of the timber supports, men were engaged upon that work, when suddenly the centre of the floor gave way and fell with a loud crash. There were at the time six men underneath, only one of whom escaped. On assistance arriving, two were extricated from the *débris*, quite dead; the others were removed to the hospitals, very much injured.

Correspondence.

GAS MANAGERS BENEVOLENT-FUND.

SIR,—As the time is now approaching for the annual meeting of the British Association of Gas Managers in London, allow me to call the attention of the members to a subject which has been long held in abeyance—viz., the practicability of forming a benevolent-fund for the help of distressed members of our body.

The subject has been frequently referred to in the pages of the JOURNAL, and some years ago, when the late editor, Mr. T. G. Barlow, was President of the Association, he made the following remarks thereon in the course of his Inaugural Address :—

There is another suggestion which I wish to make more earnestly, as it relates to a benevolent object, towards the accomplishment of which the efforts of the association may be beneficially directed. We are most of us now in the vigour of life, but gas managers are not, any more than any other men, exempt from "all the ills that flesh is heir to," and when associated together for the advancement of our common pursuit, it seems to me an appropriate time to consider the means of providing for the relief of the probable wants of the future. The creation of a Gas Managers Benefit Fund, for the relief of deserving members who may be incapacitated by old age or sickness from discharging their duties, is, I conceive, a subject justly deserving the attention of our association. Several of the metropolitan and the larger provincial gas companies have instituted such means for relieving their officers when incapable of work, and if it be thought fit to adopt my suggestion, I am willing to contribute substantially for the foundation of such a fund.

I believe that this excellent counsel was backed by the offer of a cheque for £100; and I know that at a subsequent period Mr. A. A. Croll, when President of the Association, made a similar offer.

In 1870, Mr. Warner, of South Shields, proposed to the Association, the formation of such a Fund, but it being found impossible, during the sittings of the annual meeting, properly to debate the subject in all its bearings, it was referred to a special committee, of which I remember our President for this year (Mr. Morton) was a member, to consider it in detail, and bring up a report the following year.

Accordingly, in 1871, when the Association met in Dublin, the committee reported that they had endeavoured to ascertain the feelings of the members individually on the question, by means of a circular; and they appended to their report an analysis of the replies received by them. From these replies, they came to the resolution that it was not advisable to recommend the Association to undertake the formation of such a Fund.

With the greatest respect to the members of that committee, I have thought, from the first, that their report was anything but conclusive as to the necessity for such a Fund, or as to the probability of its being sustained when once set on foot.

Their circular was addressed to the 300 members who, at that time, were actively identified with the Association, and who, from that very fact, may be presumed to have been above the need of assistance from such a Fund themselves, and we do not learn that any inquiries were made by the committee beyond this circle. From the 300 members thus circularized 92 replies were received, 40 of them being favourable to the scheme, and offers of subscriptions being made by 45. Knowing, from experience, how difficult it is to obtain replies to a circular from persons scattered all over the country, I am not at all surprised that less than one-third of the number of members of the Association troubled themselves to give an opinion on the subject; but I should be very much surprised, supposing a fund were really started, to find a less number than three-fourths of the present members enrolled as subscribers.

One of the questions proposed by the committee in their circular was, "Do you know of any cases requiring the assistance such a fund would afford? If so, please to give particulars?" The committee state that "not a single member, at present, appears to know a case in which help from such a fund is needed." It seems to me that, as the committee had only 92 replies in all, the above statement is rather too general, but let that pass. The great probability that such instances would arise is evident from the very generous remarks they add to their statement, that, in case of any member needing help, application should be made to the Association, when the committee might investigate the case, and, if found deserving, head a subscription list.

Notwithstanding this kind-hearted offer, in making which I am sure the committee rightly counted upon receiving the response of every member of the Association, I cannot think that even this meets the difficulty. What is required is a fund, which shall have its Provident as well as its Benevolent aspect, and to which a distressed member of the Association would feel no hesitation or delicacy in applying for help, knowing that he had himself contributed to its establishment. "Beggars must not be choosers," but I fancy some of our members would suffer much biting poverty before allowing the committee to "send round the hat" to obtain promiscuous relief for them.

Notwithstanding the adverse report of the committee in 1871, the subject was reintroduced to the Association in the following year by its genial and lamented President, the late Mr. Jabez Church, who in his inaugural address, after referring to the past history of the movement in favour of establishing such a fund, remarked :

From conversation I have had with members, I feel assured that a sum of money could be at once raised for the purpose, which would form a substantial nucleus, to be increased from time to time. We should thus possess a fund which would prove of essential value in assisting those of our members who may have the misfortune, either from accident or incapacity, to require such aid.

Towards the close of the sitting, Mr. Church again brought the matter forward, and moved a resolution himself, affirming the desirableness of the formation of such a Fund, which motion was seconded by Mr. Warner, and carried, in spite of what I may call, from the high reputation of the originators, a powerful opposition. The question was then referred to the General Committee, who, in 1873, reported somewhat curtly that the responses to their inquiries were, "in the opinion of your committee, insufficient to justify the recommendation of the establishment of such a Fund!"

So the matter stands at present, and I greatly fear I shall have to say the same after the next annual meeting, unless you, Sir, will allow the publication of this letter in the columns of the JOURNAL, so that some expression of opinion may be elicited on a question which, I have reason to know, is not generally considered by the members to be finally disposed of.

The distressing case which was referred to a few months ago in the JOURNAL, and on behalf of which you made "A Christmas Appeal," shows, first, that there is a real need for such a Fund; and, secondly, that there would be no lack of support if it were once established.

ALEPH.

Parliamentary Intelligence.

HOUSE OF LORDS.

THURSDAY, APRIL 27.

The Folkestone Gas and Shepton Mallet Water Bills received the Royal Assent.

The Chesterfield Water and Gas, Stafford Borough Extension, and Walsall Gas Purchase and Borough Extension Bills, brought from the Commons, were read the first time, and referred to the Examiners.

FRIDAY, APRIL 28.

The Lord Chancellor acquainted the House that no further Standing Orders are applicable to the Rossendale Union Gas Bill.

The Blackrod Local Board and Blackrod Gas Bills were committed.

GAS AND WATER ORDERS CONFIRMATION BILL.—This bill, for confirming certain Provisional Orders made by the Board of Trade under the "Gas and Water-Works Facilities Act, 1870," relating to Chapel-en-le-Frith Gas, Cromer Gas, Hythe and Sandgate Gas, Poole Gas, Neath Water, Newbury Water, Wantage Water, Connah's Quay Gas and Water, and Flint Gas and Water, was read the first time, and referred to the Examiners.

The Redcar and Coatham Gas Bill, brought from the Commons, was read the first time, and referred to the Examiners.

HOUSE OF COMMONS.

MONDAY, APRIL 24.

The Chesterfield Water and Gas, Stafford Borough Extension, and Walsall Gas Purchase and Borough Extension Bills were read the third time, and passed.

The Redcar and Coatham Gas Bill, as amended, was considered; to be read the third time.

The Edinburgh and District Water, Galashiels Municipal Extension, Police, and Water, and Sutton Gas Bills (Lords) were read a second time, and committed.

Examiners report presented—That the Standing Orders not previously inquired into, and which are applicable thereto, have been complied with in the case of the Maidenhead District Gas Bill (Lords); bill to be read a second time.

The following petititions were presented :—In favour of the Kildwick Parish Gas Bill from Landowners, owners, &c., of mills, &c., and inhabitants of Kildwick; against proposed additional provision in the Dewsbury and Heckmondwike Water Bill from Soothill Nether Local Board; against the Galashiels Municipal Extension, Police, and Water Bill (Lords) from Hugh Scott; and against the Sutton Gas Bill (Lords) from (1) Householders of Banstead, (2) Vestry of Banstead, (3) Gas consumers of Sutton and Cheam.

THAMES VALLEY DRAINAGE.

Sir C. DILKE asked the Secretary of State for the Home Department whether, during the present session of Parliament, any measure would be introduced which would prevent towns from pouring their sewage into the Thames above the point at which the supply of water to London for drinking purposes was drawn.

Mr. SCLATER-BOOTH: There is no intention of bringing in any bill having the special object indicated in the question, but a Pollution of Rivers Bill is in preparation, as the honourable baronet and the House are already aware. The Thames Conservancy Act, passed some years ago, provides for the purification of that river, so far as sewage is concerned, by the agency of the Conservators, whose jurisdiction extends up to Cricklade. They have exercised their powers, and put pressure on the authorities, with useful, though necessarily with slow results; and the Local Government Board have sanctioned the expenditure of large sums of money for the construction of works, having for their object the purification of the river. Out of a dozen or fifteen towns between Cricklade and Hampton, the following of the more important cases may be specified:—At Oxford, upwards of £100,000 is being expended; at Abingdon, £20,000; at Reading, £150,000; at Eton, £25,000; at Windsor, £30,000. Most of the works in these instances are in a forward state—some, I believe, completed or approaching completion.

TUESDAY, APRIL 25.

On the motion of Sir Charles Forster, the order of the 6th of March last, "That the Imperial Gas Bill be committed," was read and discharged, and the bill withdrawn.

WEDNESDAY, APRIL 26.

The Local Government Provisional Order, Skelmersdale, (No. 5) Bill, to confirm a Provisional Order of the Local Government Board under the provisions of the Gas and Water Facilities Act, 1870, and the Public Health Act, 1875, relating to the district of Skelmersdale, in the county of Lancaster, was read the first time.

The petition of the Corporation of Newcastle-upon-Tyne against the Newcastle and Gateshead Water Bill was withdrawn.

The Halifax Water and Gas Extension and Wakefield Water Bills were referred to a select committee, consisting of Mr. Ellice (chairman), Mr. W. H. Gladstone, the Marquis of Hamilton, and Mr. Wroughton; to meet on Thursday, May 4.

The Newcastle and Gateshead Water, Burntisland Burgh, Campbeltown Burgh and Harbour, Paisley Water, and Spennymoor and Tudhoe Gas Bills, were referred to a select committee, consisting of Col. Loyd Lindsay (chairman), Mr. Portman, Mr. Benett-Stanford, and Mr. Stephen Moore, to meet on Thursday, May 4.

THURSDAY, APRIL 27.

The Redcar and Coatham Gas Bill was read the third time, and passed.

A petition was presented by Mr. Torrens, from the Vestry of Islington, praying that the New River Company may be prevented raising their annual charge for the supply of water, and that the same may be placed under the control of a public body elected by the ratepayers.

The petition of John Fullarton Patrick and others against the Paisley Water Bill was withdrawn.

FRIDAY, APRIL 28.

The York New Water Bill, as amended, was considered; to be read the third time.

A petition for additional provision in The Gaslight and Coke Company's Bill was referred to the Examiners.

The Kildwick Parish Gas Bill was reported.

BURGHS (SCOTLAND) GAS SUPPLY BILL.—A petition for alteration of this bill was presented from Motherwell, and one in favour from Hamilton.

The Local Government Provisional Order, Skelmersdale, (No. 5) Bill, was read a second time, and committed for Monday, May 8.

HOUSE OF COMMONS COMMITTEE.

FRIDAY, MARCH 24.

(*Before Mr.* ORR-EWING, *Chairman; Col.* RUGGLES BRISE, *Lord* RENDLESHAM, *and Mr.* BROGDEN.)

STOCKTON AND MIDDLESBROUGH WATER BILLS.

(*Continued from page* 611.)

Mr. *Rowland*, examined by Mr. BROWNE.

I am a plumber, living in Yarm, and have been in business there for 19 years. I have been very often employed, by various inhabitants and manufacturers, to lay pipes into the river, with the view of enabling them to pump fresh water for drinking, and also for manufacturing purposes. The flow is about 7 or 8 feet there. The inhabitants would be able, by means of these pipes, to pump fresh water from the river from three to four hours.

By the CHAIRMAN: The tide varies considerably. It rises from 5 to 8 feet at Yarm.

Examination continued: I have noticed in recent years that the river is very much lower than it used to be. I account for that by the fact of the abstraction of water above that point by the water company. I have been called upon from time to time, in consequence of this fall of the river, to lengthen several of the pipes in order to reach the water. I have also been asked to construct wells. Some five or six years ago I tried to get wells to work; but only one is working at the present time. I cannot keep the pumps in working order, because the river is so low that they get filled up with sand. I remember laying pipes for the Union Brewery in 1867, and again in 1870. They have not been working for four years now, in consequence of the difficulty of drawing water from the river. I also lengthened a pump for Messrs. Jackson, in 1870. I sunk a well in the foreshore, but it was laid off in 1872; and this last winter they have given up fresh, and taken to tidal water. I put in a pump in 1868 for one gentleman, but it has been disused since 1872; and another first pumped from the river in 1868, but his pump has been in disuse since 1871. The river at Yarm runs very deep from the Durham side, and a decrease of three or four inches in depth leaves the foreshore perfectly dry on the Yorkshire side. I do not think the bed of the river has changed at Yarm. There is more gravel to be seen, but I account for that by the abstraction of the water. There are several rocks now to be seen, which used to be covered with water. I know the paper-mill at Yarm. It used to formerly manufacture white paper, but it is now used for blue and brown paper. I cannot say why the change has been made, whether it is owing to the change in the water.

Cross-examined by Mr. SUTTON: There has been no dredging going on below Yarm for seven or eight miles, though there has been, I think, from Stockton downwards. The decrease on the Yarm side was more from 1868 to 1870 or 1871 than it has been since; but it has still kept decreasing. I do not think they have abstracted an increase of water in proportion. The Durham side has not increased at all in depth. There are rocks there, and sometimes an accumulation of sand at different places, which is carted away from time to time; but there is no changing of the sand from one place to another. I do not think the deep water channel has shifted at all on the foreshore of Durham.

Re-examined by Mr. BROWNE: The recession of the water could not be accounted for by the deepening of the Durham side of the river. I know the river Skerne. It is a tributary of the Tees, the volume of which is considerably increased by the flow of that river. There is another river running from the Yorkshire side. About the junction of the Tees with those two rivers, the abstraction of the water would be even more felt than it is at Yarm.

Dr. *Young*, examined by Mr. BROWNE.

I have been in practice at Yarm for some time, and have taken an active part in endeavouring to obtain a good supply of water for that town. I am chairman of the Sanitary Committee, and know the diseases from which the people in Yarm principally suffer. In 1873 the desirability of obtaining a regular supply of water was discussed by the Sanitary Committee. It was suggested by Mr. Naldor that we should communicate with the Stockton and Middlesbrough Company. The negotiations fell through, in consequence of that gentleman's death. There was another meeting held subsequently, at which it was resolved to endeavour to obtain water for all purposes. I was then, with another gentleman, appointed as a deputation to the company, and we waited on them in 1874. The company offered to supply Yarm with water for all purposes at 1s. per 1000 gallons. We were to supply our own plant, and pay the water-rates. The company's pipes are, I should think, at the present time, less than 400 yards from the town. We declined the offer of the company, as, if we had acceded to it, it would have cost the town £514 a year. The population is about 1400 to 1500, and has increased since the last census. Upon the failure of the negotiations with the company, the Yarm Sanitary Committee resolved to erect their own works, and pump from the Tees above Yarm. We should have been able to supply, by that means, about seven million gallons a year. That would have cost us 6d. per 1000 gallons, which would have included charcoal filters and everything. We considered it chemically necessary to filter our water with charcoal. The project has not been carried out, in consequence of the Local Government Board refusing to allow us to borrow the necessary money. There are three or four mills on the river on the west side, and the outflow of the mills goes into the Tees. The chief supply to the inhabitants is from the river on the east side. They get their water in buckets, which have to be carried. There is a large amount of mineral deposit in flood-tides in the bed of the river during the winter. The water is turbid, and unpleasant for drinking purposes. Most of the poor people are without charcoal filters, but they allow the water to stand in the buckets for several hours, in order to get rid of a portion of the sediment. I made some observations in the autumn of last year, and found that the flow of the water had largely decreased. There was a prevalence of typhoid fever at the time, but it was chiefly confined to about half a dozen cottages. In consequence of the water not being easily obtainable direct from the river, some of the inhabitants had procured it from a reservoir connected with some flour mills. The water was supposed to be impregnated with a certain quantity of animal matter. Two deaths from typhoid fever occurred, and a general sickness followed, which I attribute to the state of the water.

Cross-examined by Sir E. BECKETT: The water that was taken out of the reservoir came from the Tees—nothing but the water went into the reservoir. A great many people in Yarm drink Tees water. So that if the sickness could not be attributed directly to the water it was the consequence of the defective arrangements for the supply at Yarm, which involved the necessity of the people going to the reservoir at the flour mills for water.

By Mr. PEMBER: When we were thinking of getting a water supply of our own in 1873 we were going to pump from the Tees above Yarm at low water. No particular reason was given by the Local Government Board for their refusal to sanction the loan, but it was said that the sewage of Darlington coming down the Skerne, would make the water bad above Yarm. I should not call 22 a high death-rate for Darlington, but rather a low one.

Re-examined by Mr. BROWNE: All persons who are exposed to an epidemic or infection do not die; and the fact that all those who drink the water do not die of typhoid fever, does not prove that the water is not deleterious. Some of the people take their water from the mill reservoir, the water for which is got from the Tees; after supplying the mill boiler it is returned to the river. As to the Darlington death-rate, I think good water would bring it down still lower.

Mr. *George J. Symonds*, examined by Mr. BIDDER.

I am the secretary of the Meteorological Society, and of the Rainfall Committee of the British Association. I have collected for 16 years the statistics of the rainfall, and have the record of more than 1500 stations through the country. I was asked last autumn to examine the rainfall of the whole Tees valley. I have the averages from 1857 to 1875, besides which I myself established 17 rain-gauges in the district to give a fair indication of the rainfall. I took the observations myself, with the exception of two, for which I gave careful instructions. The new observations were taken from October, 1875, to February, 1876. I found what had been the rainfall at the old stations during the period the new gauges were in operation, and then ascertained what proportion that short period bore to the long series of observations; and applying this, I obtained a general annual average. During the five winter months the rainfall is about 50 per cent. of the annual fall, and during the four months from November to February it is 38 per cent. of the mean annual fall. I found from this that the rainfall of the Tees district varies between the limits of 61·58 inches at the greatest station, down to about 40 in lower grounds; and I have reason to believe that those observations truly represent the approximate rainfall of the district.

Cross-examined by Sir E. BECKETT: These figures are founded only upon the observations of those four months, of course. I issued regulations to shepherds, gamekeepers, millers, and others, who were to make certain observations; and my calculations depend upon due attention being paid to those instructions. Snow would fall through the wire bar of the gauge as well as rain.

Mr. PEMBER: In the report of the Rivers Pollution Commissioners for 1874, it is reported that in Darlington and Stockton the water was not contaminated with sewage.

Mr. BROWNE objected that the witness only came to speak to the rainfall; and chemists would be called to speak to the quality of the water.

The CHAIRMAN thought these questions had better be asked of the gentlemen who had made analyses of the water.

Re-examined by Mr. BROWNE: I thought the instructions I gave were the best for ascertaining the rainfall of the district, and if I had to ascertain it again, I should use the same means. In such a district it is only possible to get cottagers and gamekeepers to watch the gauges, and if the company set up gauges, they would have to do the same. I saw several of the company's gauges, which were well placed, but they were not so easy to read as mine. The cross bar was no difficulty in the way of reading. I put every one of the gauges up myself; and I have no reason to doubt the accuracy of the results I have given to the committee.

By the CHAIRMAN: The rainfall is not so great as I should have anticipated. The Cumberland district being much higher probably attracts the rain clouds more.

Mr. *William Gunn*, examined by Mr. MICHAEL.

I am an assistant on the Geological Survey, and have an intimate knowledge of the basins of the Lune and Balder. They stretch east and west, and the length of the two valleys is nearly the same. Balderdale is between two and three miles in breadth, while Lunedale is rather pear-shaped, ranging from seven or eight miles to a mile in breadth. The greater part of the catch basins is in Yorkshire, but a small portion is in the county of Westmoreland. The main watershed is at the head of the two dales in high ground, separating it from the river Eden. The whole of it is moorland I believe, and it declines gradually towards the east. There is a considerable amount of peat, with some bare patches, but between four or five miles from the head it declines rapidly to the river, and there is no peat. The watershed between the Lune and Balder declines more rapidly than that between the Balder and Deepdale; and there is not so much peat. The Balder rises in two or three principal streams in Westmoreland, and has only two tributaries. The Lune rises in the high part of the district, in Lunehead Beck and another stream. There are several becks running into it near Mr. Milbank's house, and there are a good many springs, for the peat retains the water, and gives it out during the summer time, so that it acts as a perennial spring. The streams come out of the great limestone bed of the district, at Lunehead, and the descent of the stratification is a little south of the river Lune, rather nearer the Balder. The beds sink towards that, from the north and the south, in angles of 15 degrees, or more, from the north, and from five to ten in the south. These depressions make the beds of the Lune and the Balder. We often find those strata depressions do not correspond with the surface depressions or valleys, but occur even under hills. They belong to the carboniferous formation, which includes the coal strata. It is a subdivision of the formation called the Uredale. There are some patches of millstone grit through the strata forming a fault. There are not many igneous rocks, and they are ignored in the geological maps, although they crop up occasionally. In some places there is a great deal of glacial drift, but they are chiefly in the low ground. They mainly consist of stiff clay and igneous rocks, which have come out of the lake country and been deposited there. I should call them by the generic term of boulder clay. As to the reservoir site on the Balder, it is admirably placed, because it is made in shale, which is impervious, and half of the north side is of boulder clay, which is also impervious. On the south side, shale and boulder clay alternate equally. The bottom of the reservoir is on a thick shale bed, and not a better stratification for a reservoir could be selected. The Hury reservoir is partly on the millstone grit, and there is some alluvial deposit on the bottom; but they rest either on shale or boulder clay, the very same bed as the Balder reservoir. There are outcrops of rock and shale, and some boulder slips at the Balder reservoir, but not of much importance. The fault is not there, but farther down, at the lower part of the reservoir. It cannot be seen, but may be inferred from the general appearance of the country. It is obscured by deep boulder clay, so that it cannot possibly do any harm to the reservoir. Borings have been taken on the reservoir, and on the north side a 14-feet boring did not get beyond boulder clay. A boring in the bottom went through 6 feet of gravel, a stone bank, and into the shale bed 14 feet, at another place 6 feet of boulder clay and 7 feet of shale. I think nothing could be better adopted for a reservoir, as at every point we come down to an impervious stratification. The Hury site has thicker deposits, there being a narrow patch of alluvial gravel near the river, and another on the boulder clay, which is glacial gravel of the same date as the boulder clay itself. It is a very good site both for the reservoir and the embankment. I should think there are 24 feet or more of shale under the bottom of the embankment. I have examined the Grassholm reservoir on the Lune, which is a great part on sandstone and limestone. On the north side there is a thick coating of boulder clay. The southern side is half rock, and the rest covered with boulder clay as on the north side. Looking at it geologically, it is a good site for a reservoir, as nothing can be better than boulder clay, unless it is shale. In the proposed embankment of that reservoir there is nothing but boulder clay along the side, and nothing could be better for the purpose.

Cross-examined by Sir E. BECKETT: I cannot say I have had anything to do with making reservoirs, but I have seen them made. I do not know anything about the Rochdale reservoirs, but I know the Wharfedale formation. I have heard that some of the reservoirs there cost very much more than anybody expected. There is the Leeds reservoir, for instance; but that is not the same formation as here. I am sure there is no sand below this site, for, from my experience, there is no sand in the boulder clay. There is a fault near the Hury reservoir, but I do not know that two faults meet there. I do not know that they are depicted in Professor Phillips's geological maps. I can say there is nothing to lead to casualties in the construction of the reservoirs. I cannot say I have ever advised before on the site for reservoir embankments.

Colonel *Scourfield*, a riparian owner on the Tees at Hurworth, said that he had noticed the diminution of water in the river since the company began to

pump. This had injured the angling, for salmon did not freely pass up in the summer, on account of the smallness of the stream. He had walked across Dinsdale dam more than once. In dry weather the river was very bad where the Skerne joined the Tees, being foul, polluted, and offensive. Indeed, fish would not pass through the Skerne water unless it were diluted with purer water. He identified photographs as fairly representing the appearance of the river at various points in dry weather, below the company's pumping-station. He had noticed the state of the river in consequence of the hush from the lead mines, which prevented the fishing.

In cross-examination, he stated that he did not know when the decrease in the river began. It was steadily decreasing until two or three years ago. He believed an injunction had been obtained for the purpose of compelling Darlington to keep their sewage out of the Tees, and when that was done the water would probably be improved. The hush was not caused by the floods, but by the lead mines.

Mr. *Henry Powell*, of the Geological Survey, and stationed at Darlington, said he had examined the sites of the proposed reservoirs, and agreed with the evidence that had been given on the subject.

Dr. *Frankland*, examined by Mr. MICHAEL.

I was a member of the Rivers Pollution Commission, and have studied the waters of this district. I know the upper part of the Tees basin well, and also the condition of the waters of the Lune and Balder. I have visited Barnard Castle, and know the condition of the sewage there. That sewage, being discharged at Barnard Castle, will arrive at the pumping-station of the water company in almost the same condition. You could not say that it was potable water, even though you might be unable to detect sewage contamination by chemical analysis. The sewage might be so diluted that you would not be able to detect the impurity. There would be much less likelihood of discovering contamination before it got to the pumping-station than lower down between there and Middlesbrough. It is from the presence of nitric acid and ammonia that you detect the presence of sewage. The nitrates and nitrites would be converted from the sewage, by contact with oxygen in passing through the water. I have no hesitation in saying that water which has been contaminated by sewage, from such a town as Barnard Castle, is entirely unfit for domestic purposes. The water might be contaminated with sewage with impunity for years; but, where patients suffering from cholera or typhoid fever discharged into the stream, the whole would become infected. I know of a village where an epidemic broke out from such a cause. It is impossible to isolate the injurious matter from the water by any scientific operation, although it is believed that boiling the water will destroy it. On the 4th of February I made an analysis of the waters of the Balder and Lune. They are very soft, and suitable for washing purposes. There is some, but not a large, impregnation of them with peaty matter. I think the water would be very suitable for the supply of Middlesbrough.

Cross-examined by Sir. E. BECKETT: I made an analysis of the Tees water at the pumping-station of the water company, and also lower down the river at Stockton. From those figures I should say that, if the water had been efficiently filtered, it is by no means a bad water. It is a fact that a run of 14 miles will not oxidize the water. I have not asked whether any person agree with me in that opinion. The late Baron Liebig did, and Professor Dumas, Dr. Hill, and Professor Williamson, of University College, do. A run of less than 200 miles will not oxidize impure water. Nothing has been more clearly shown in these investigations than that water mixed with what is called healthy sewage is not injurious. It is only when it is mixed with sewage discharged by persons suffering from typhoid fever or cholera. A small quantity of sewage will render water injurious if it be infected. The passage of sewage through a few feet of gravel effects a much greater oxidation than a run of 100 miles would. Analysis enables us to ascertain whether the contamination comes from animal or vegetable matter. The latter is not so injurious as the former. The samples that I examined last year of water flowing past Tees Cottage were of a very different character from that which I analyzed this year. From the analysis I should say that the water this year was impregnated with vegetable matter. I found nothing injurious in the water that the company were delivering last year. The proportion of the carbon in organic matter in the Stockton water is 1-20th; but that was after filtration. In the Balder it is 1-10th. The Balder water in a crude condition has ·024 nitrogen, that of the Tees, filtered, has ·015. So that the Tees water is the better. All that I really know about it is, that Barnard Castle discharges its sewage into the Tees.

Re-examined by Mr. MICHAEL: That shows the necessity for examining the water chemically, with the object of detecting, if possible, whether the germs of disease are in the water. As a general corollary to the water being contaminated at Barnard Castle, I should certainly say it was unfit for domestic purposes. There is no security against disease if such water be used.

Dr. *Hill*, examined by Mr. MICHAEL.

I am Professor of Chemistry and Toxicology in Queen's College, Birmingham, and medical officer of that town. I have had considerable experience in the analysis of water. I know the results of Dr. Frankland's experiments as to the oxidation of sewage by the flow of water, and I agree with him. I have made analyses of water from the rivers Balder and Lune. It is a remarkably pure water, but is of slighty peaty character, and a little discoloured, owing probably to the disturbance of the water at the time it was taken. The organic carbon is moderately large, but if the water had been smooth at the time it was got from the river, it would no doubt have been less. The organic nitrogen is small in itself, and very small relatively to the carbon. There are no nitrates or nitrites, and no ammonia whatever. I do not think the water of the Tees could be purified sufficiently to make it absolutely safe for domestic purposes. I am convinced that the supply of water for the district should be from some source not contaminated with sewage at all.

Cross-examined by Sir E. BECKETT: A spoonful of unhealthy sewage put into the Thames at Oxford would be sufficient to cause an epidemic in London.

Re-examined by Mr. MICHAEL: The farther up the river you go, the less risk of contamination, and going above the source of the sewage pollution will give a better supply of water.

Dr. *Odling*, examined by Mr. BROWNE.

I am Professor of Chemistry in the University of Oxford, and made analyses of water for the Royal Commission, in 1867. On the 15th of March last I had some samples sent me for examination by Mr. Mansergh. They were said to be samples of water from the Lune and Balder. I found them of excellent quality for a town supply, and free from contamination by animal matter. They were pleasant to taste and in appearance, fairly bright, and in a tumbler had no appreciable colour. In larger quantities they had a greenish tint, but there was nothing in that to show they were deleterious.

Cross-examined by Sir E. BECKETT: I know nothing of the Tees water, not having analyzed it, or been at the place. From Dr. Letheby's analysis last year, I have no doubt it is a fairly good water. I agree with Dr. Frankland's view in some respects; but it has never been demonstrated to me that drinking water impregnated with sewage from fever patients causes disease. At the same time there is a substantial risk in having the sewage of Barnard Castle pumped out with the water at so short a distance. I should not object to drink the water at Darlington, knowing that the Barnard Castle sewage was in it; but if there was an outbreak of typhoid at Barnard Castle, I should fight shy of it. I should be inclined to pay considerably more as a ratepayer to get a pure supply, and I think I should be inclined to pay more to get the Lune and Balder water instead of the present supply at Darlington and Stockton. Thames water is practically excellent, although there is sewage in it. I do not know whether the Tees or the Thames water is the better; but if the Tees is the better, *à fortiori* I should be satisfied with it. There is a larger proportion of sewage sent into the Tees in the same distance than there is into the Thames; and on that account I should probably prefer the Thames. Water running over stones as in the Tees, and being exposed to the air, would become purified in a shorter time than if the river were deep.

Re-examined by Mr. VENABLES: The question of the addition to the rates that will be necessary if this bill passes, is one for the ratepayers; and if there be a real risk, no amount of rate ought to deter people from the expenditure. If there were typhoid fever at Barnard Castle, there would be a risk which I would not like to run.

By the COMMITTEE: I think dilution and time have an effect on purifying water, and in that respect I differ from Dr. Frankland. Filtration has a partial effect.

MONDAY, MARCH 27.

Mr. *James Mansergh*, examined by Mr. BIDDER.

I am a member of the Institution of Civil Engineers, and have had an experience of 25 years in connexion with public works. My firm have carried out water-works in from 26 to 30 towns. I know the Stockton and Middlesbrough Water-Works, having been consulted last year by the company, and reported upon their bill. I gave evidence last year upon the water company's bill. In the course of the inquiry an undertaking was given by the corporations, that in case the company did not provide a pure supply of water, the corporations would do it. Several witnesses stated that the Corporations of Stockton and Middlesbrough instructed me, in consequence of the company having taken no steps in that direction, to devise a scheme for bringing pure water to those towns. The population of the district is very largely increasing. In 1851 it was about 7893; in 1861, 18,992; in 1871, 39,563; and at the present time it is supposed to be about 70,000. Stockton has been increasing in a very similar ratio. In 1864 the average weekly consumption of water was about 13 million gallons, in 1874 it was 50 million gallons. At the present time about 130,000 people are dependent on the company for their water supply. That number in the course of the next 12 years will probably increase to about 250,000 which would necessarily imply a corresponding increase in the consumption of water by the iron-works, because the population increases with the trade. Taking 50 million gallons per week as the present requirement for manufacturing purposes, something like 80 or 90 million gallons will be required in another 12 years. With regard to the filtering arrangements of the company, I cannot speak from personal inspection. I made an application to examine them, but it was refused. From Mr. Hawksley's evidence, given last year, it would appear that neither the area of the filters nor the capacity of the reservoirs is sufficient to ensure the reasonable purity of the water. Mr. Hawksley said the proper speed of filtration was six inches an hour; but the area in use by the company would necessitate a filtration at the rate of nine inches an hour, that is 50 per cent. too fast. The effect of that is, that the water is only half filtered. The river Tees often comes down with the flood, and the water is then thick, turbid, and highly coloured. No doubt it would be a very costly thing to provide a supply of pure water for this large district. I think, however, the outlay would be much better made in endeavouring to procure a fresh supply altogether, than in patching up the present machinery of the impure supply. It must happen, if the company's application for an increase of 50 per cent. in their pumping power be granted, that half the minimum flow of the river above the pumping-station will be abstracted. At the pumping-station the water is lifted from the river into the subsiding ponds, whence it passes to the reservoirs. Those subsiding ponds contain about seven-eighths of a day's consumption. Therefore, if the water comes down in a flood for two or three days, they have to take the flood water. They have the Fighting Cocks service reservoirs, which contain about 2½ days supply. If, however, the river came down in a flood for two or three days, they would draw from those reservoirs; but when the reservoirs are empty, they must pump faster at the pumping-station to get them refilled, and they are ordinarily pumping too fast for their filtering arrangements. I have gone up the river with a view to seeing what sewage is discharged into it. Barnard Castle, with a population of about 5000, and the other villages along the river, discharge their sewage into it. I should think it probable that those places will increase in population, and, therefore, the sewage pollution is likely to become greater. I have heard frequent complaints made of the state of the water, and have myself seen large masses of fœcal matter on the river banks. The power of abstracting 90 million gallons a week, which the company seek, would take away nearly half the dry weather minimum flow of the river. I believe the minimum flow is about 27 million gallons a day. The basis of calculation upon which that figure is arrived at is a quarter of a cubic foot from each 1000 acres of watershed. I have carefully measured the number of acres above Tees Cottage, and there are 200,000. When Mr. Hawksley put the minimum flow at 43 million gallons, he made the mistake of taking the number of acres of watershed at 300,000. In point of fact, the watershed is 200,000 acres. The dry weather flow is, therefore, two-thirds of Mr. Hawksley's estimate of 43 millions, and that would work out at about 27 millions. That result has also been demonstrated by observation. Taking the proposed increased quantity required by the company at 90 million gallons a week, that would be equivalent to 13 million gallons a day, which, in dry weather, would be nearly half the minimum flow, and this would have a very serious and prejudicial effect upon the river below the point of abstraction. The maintenance of fresh water in summer time is important, for the purpose of keeping the river clean and sweet, and also for helping to carry the sewage down to the sea. The tide runs up to a little beyond Yarm, and nearly up to that point the sewage of these large towns goes up and down; and, unless there is a preponderance of land water to carry it seawards, there would be a continual nuisance. My primary object in designing this scheme has been to obtain the water from above the sources of pollution—that is, to get pure water, uncontaminated by sewage. The gathering-grounds that I have selected are particularly free from any sewage contamination. By far the greatest portion of the land there is open moorland, uncultivated and unpopulated. The rivers Lune and Balder are unquestionably the most convenient for the water supply. They are of sufficient height to readily admit of gravitation in assisting to distribute the supply. The Hury reservoir is 860 feet above the mean tide level. That will secure a large saving in the expense of pumping. In my judgment, it is most desirable to go to the upper parts of the river for a pure supply, because it must be done sooner or later. Having regard to the present and prospective increase of Stockton and Middlesbrough and the district generally, my opinion is that another source of supply must be found, because in 20 years time the company would want the whole body of the river. I have selected the Lune and the Balder, because the only other sources available were the Deepdale Valley—which supplies Barnard Castle, and seems naturally to belong to it—and the Greta, which is not at present utilized, but which, being nearest to Darlington, I thought it right should be left at their disposal, in case they should become dissatisfied with the present supply, and yet not wish to join with us. Under all the circumstances, therefore, I thought the Lune and Balder were the most eligible for our purposes. In including Darlington in our scheme, I acted upon the recommendations made by the Royal Commission on Water Supply in such cases. There is plenty of water in the Lune and Balder to supply them with. The whole area of the watershed we take is 29,000 acres, of which 18,900 are on the Lune, and 10,100 on the Balder. At certain times of the year, the water is no doubt somewhat discoloured, as there is an accumulation of peaty moss on the surface of the rivers in summer

time, and that tends to discolour the water. In the winter, however, it is perfectly colourless. For the last three or four months it has been very clear indeed. We have made arrangements for storing a large quantity of the water in its purest condition. On the Lune I propose to make only one reservoir for compensation water, and another on the Balder, to pass dirty water round the upper reservoir into the river, and by that means the water can be selected and assorted, and turned into any of the reservoirs. That will give 1800 million gallons for compensation, and leave us 906 million gallons for domestic supply, and that quantity will give 11¼ million gallons per day. We would still keep available the present powers of the company to take from the river for the supply of the iron-works. By putting in an additional conduit in eight or nine years time, we could bring down the whole of the supply; and even by the present pipes we could bring down sufficient to supply the existing population. The area of the Hury reservoir is 127 acres, the Blackton 67 acres, and the Grassholme 140 acres. The locality is exceedingly favourable for the construction of reservoir embankments. The compensation is on the Lune 6,264,000 gallons per day, and on the Balder 3,348,000, being nearly 10 million gallons altogether; so that in dry weather we should be able to give to the river almost as much as the company now take from it. I think the supply is 33 million gallons to iron-works, and 22 million gallons for domestic supply per week. Our compensation reservoirs would, therefore, give more to the river than we pumped out for manufacturing purposes. I base my calculations on the ascertained rainfall. It is provided in the bill that the compensation water shall be discharged in a regular, equal, and constant flow. We should be able to give more in compensation than is stated in the bill, for I had not Mr. Symonds's statistics at the time I made my calculations, and I wished to state a safe figure. The compensation due to the Balder is 4360, and to the Lune 2320 gallons per minute. All the millowners are quite satisfied with that. We make a brick or stone reservoir at Lartington, and then an iron pipe will go to the Whorley reservoir, where the long line of pipe will be broken; then the pipe will go round by Darlington to the Sadberge reservoir. The distance from the Hury reservoir to the pumping-station is 20 miles. The Sadberge reservoir will hold 8 million gallons, and is 80 feet higher than the Fighting Cocks reservoir belonging to the company. I have adopted the Sadberge site as recommended by Mr. Hawksley. The pipe will run from Sadberge through Stockton to Normanby, crossing the Tees just above the old stone bridge at Stockton. Passing under the Tees at Stockton, the pipes would be laid in duplicate, being there 33 inches in diameter. We could lay the conduits to the Lune and Balder in as short a time as the company could build new reservoirs. It would probably be in two and a half or three years. The reservoirs would not be ready then, but so much water would be brought down by gravitation as would reduce the cost of pumping. It would also temporarily increase the supply until the reservoir should be completed. I should begin on the Balder, and probably take five or six years to complete the works; and when they were nearly finished, I should begin on the Lune.

Cross-examined by Mr. SOMERSET: For some time we should have to depend on one pumping-station, and it would be six years before we could give a domestic supply from our own works. I should be able to give about 3 million gallons then from the Hury reservoir on the Balder. I expect it would be finished in six years. Before making the reservoir, I propose to take a conduit up to the Balder and give a supply. We shall give no compensation, during that time, in water; but if there is any claim by millowners, we may settle them with the money which had been saved from the pumping works. There is nothing in the bill for this, however. The estimate which I prepared certainly does not give any idea about it, except the total sum. It gives no detail, but it is all we are bound to put in.

Mr. SOMERSET submitted they were entitled to detailed estimates.

Mr. BROWNE objected, and asked if the estimates had been given in the usual form.

Witness said they were, as would be seen on reference to the deposited plans.

The CHAIRMAN: You do not intend to lodge detailed estimates?

Mr. BROWNE said all that was required was given in the bill.

Mr. SOMERSET said it was only fair that they should know the details, in the interest of the ratepayers as well as of the company. If the works of the company were to be taken, they should know whether the estimates were sufficient.

Mr. BROWNE was willing, at the dictation of the committee, that Mr. Mansergh should prepare the detailed estimates; but, if so, the company should be compelled to do the same as to their scheme.

Mr. SOMERSET would deal with that question when it properly arose, but at present it was necessary to have the details of this bill.

Mr. SALISBURY joined in the request for the detailed estimates, so as to enable the witness to be cross-examined on all points.

The CHAIRMAN thought the lands proposed to be taken were sufficiently shown; but the other objection was more serious. What had been lodged was all that was required by Parliament; but it would be more convenient to have the detailed estimates. At the same time, if the rules had been complied with, he did not see how the committee could interfere. The opponents might make their own calculations on the deposited plans.

Cross-examination resumed: I believe the correct area of the gathering-ground is 200,000 acres. Mr. Hawksley said it was 212,000, and afterwards corrected it to 202,000. The evidence of Mr. Hawksley in 1864, as to the minimum flow, agreed with mine; and he made a mistake last year. I am not aware that the population above the intake is smaller than it was in 1861 or 1871. I looked at tables for 1871, but I do not remember that I looked at those for 1861. I know about the minimum flow, besides what other people have told me. I have taken the evidence of the Duke of Richmond's Commission in 1869, but it was not given in terms. I took the area of the Thames basin above the intakes of the London water companies, and what has been proved the minimum flow of the Thames, that I found worked out to 2·08 of a foot per 1000 acres per second. I have not measured the flow in this district, but I have reasoned it out. The minimum flow of the Thames is 350 million gallons, and the London water companies have power to take 150 million gallons. I have known the lower part of the Tees district four or five years; but I had not been in the upper part until last year, except crossing on the railway. I did not gauge the river, because it was one-third flood, and not nearly at the minimum. The dry season is about July or August, but when I saw it in July it was not at its minimum. I had more sense than to gauge it then. I am not aware that any gentleman did gauge it last year. I gave the minimum flow from my knowledge of similar gathering-grounds, and the evidence given by Mr. Bateman as to the flow of the river Thames. Mr. Bateman said the minimum flow was one-fourth of a cubic foot per 1000 acres per second. I cannot tell you in what year the minimum flow of the Tees was 27 million gallons. I cannot say whether it was so in 1870, a year of extreme drought.

Mr. SOMERSET: Then, in fact, you, the engineer for the corporations, have not thought it right either to gauge the river or to fortify your evidence as to the minimum flow?

Witness: But I have given it from a similar area. I know Rotherham, the area of which is 1200 acres, and this is 200,000 acres, but I prefer to take a larger area. I am aware that although the minimum flow of the Thames was found to be 350 million gallons, the commission thought it would be a fair thing to call it 400 million. I made a report in 1875 to the Darlington Corporation, in which I stated that the rainfall varied from 20 to 40 inches. I took the authority of Mr. Symonds for that calculation. I stated there that I believed the minimum flow was 50 million gallons, but I referred them to Mr. Hawksley, as knowing all about the question.

The CHAIRMAN said that the witness did not appear to be positive, when the evidence was referred to. He only said that it was possible that not more than 50 million gallons passed the company's works.

Witness then gave the details of the estimates for the construction of the works, the total cost of the Grassholme reservoir being £115,903 15s. The cost of land and laying pipes through private property would be, for the three reservoirs, £82,000. The cost of the Blackton reservoir was estimated at £71,064 16s. 8d. There was the small reservoir at Thorley, the cost of which would be £1630, and the service reservoir at Normanby £3200; the grand total cost of the works, including land, being £700,000.

By Mr. PEMBER: I have no doubt that, if it was necessary, an injunction could be obtained to restrain the discharge of the sewage into the river from the several towns above the company's intake; but it has taken seven or eight years to restrain Darlington from doing so.

By Mr. SUTTON: I cannot say when Normanby will benefit by the corporation's works—perhaps in six years. My estimate is for the works shown on the parliamentary plan, and we do not want to use distributing-pipes, so there is no allowance for them.

Re-examined by Mr. BIDDER: The distributing-pipes that the company have laid down we shall, of course, use. As regards the minimum summer flow of the Tees, the Duke of Richmond's Commission took the same method of arriving at a conclusion on that point as I have done, and so did Mr. Hawksley; but he has taken a larger watershed area than I think the fact allows.

Mr. *Appleton*, Mr. *Elam*, and Mr. *Walker*, residents in the neighbourhood, were called to give evidence as to the water company's charges, and as to the effect likely to be produced if the company were allowed additional power of abstraction of water from the Tees.

The CHAIRMAN suggested whether it would be worth while to bring any more evidence on this point.

TUESDAY, MARCH 28.

Mr. *Robert F. Reed*, examined by Mr. BROWNE.

I am a surveyor and engineer at Stockton, and, having been in practice there for many years, know all the district. I was employed by the joint committee of the two corporations as surveyor for this undertaking. In conjunction with Mr. Mansergh, I surveyed the district that the corporations propose to go to for their supply. I went all up and down the Tees Valley, and I came to the conclusion that the proper sources of supply were the Lune and Balder. I generally agree with what Mr. Mansergh said in his evidence, with regard to the practicability and advisability of the scheme. I have paid considerable attention to the amount of land that will be taken from the proprietors for these works, and my valuation of the land agrees with that given by Mr. Mansergh. £82,000 is the estimate for the land. I am in communication with many of the proprietors, and I think the whole of the land could be bought for £4000 less than I estimated at first. The total land required for all these works is about 410 acres. The land for the Grassholme reservoir, with the exception of a small piece of mead, belongs to Mr. Bowes, who petitions for this bill, and his agent, Mr. Dent, has given evidence in its favour. Out of the 410 acres, owners and lessees to the extent of 54 acres, or about one-eighth of the whole, have petitioned against the bill. [The witness entered into details showing the holdings of the various lessees opposing the bill, and pointing out that some of them would not be at all affected by the scheme of the corporations.]

By the CHAIRMAN: All the land that will be taken will be paid for; and, where estates are injuriously affected, but not taken, I have put an extra compensation to the extent to which they are damaged.

Mr. *George H. Hill*, examined by Mr. BROWNE.

I am a civil engineer, and have had considerable experience in the laying out and execution of large works, especially those for the supply of water. I have been in practice more than 30 years, and am at present in partnership with Mr. Bateman, who is in bad health, and has not attended to business since last July, otherwise he would have been a witness in favour of this bill. I was connected with the Glasgow Corporation when getting their supply of water from Loch Katrine. The Manchester Water-Works are at present in my hands. The arrangements there are very similar to those by which this scheme is intended to be carried out. In the autumn of last year I visited the Tees district, and examined it, and have more recently gone through the estimates for this bill very carefully. I have also considered the tapping for the flood water proposed by Mr. Mansergh. I regard his estimates for the scheme as ample to cover the whole of the works, judging by the prices that at present rule for works of this nature. At the present time, I have seven or eight reservoirs in course of construction, and if I had had the making of these reservoirs my estimate would have been the same as that of Mr. Mansergh. It is a very full one, and includes an allowance for puddle trenches. They are very difficult to estimate, but I examined the ground, heard the evidence given by the geologist, and have no doubt the sum put down in the bill, so far as it was possible to ascertain it, will cover the cost of that part of the work. There was no very reliable information with regard to the rainfall in this district until Mr. Symonds gave his evidence. I believe it had only been taken for five months before. It must be rather less than 30 inches in the dry, and between 45 and 50 in the wet season. The greatest amount of rain will, I take it, fall upon the west side of the hills. The rain return in the lake district proves that there is a large quantity there, and as you go eastward it lessens rapidly. I think that one-third of the rainfall would be ample compensation to the owners on the Tees for the water taken from the Lune and Balder. I have gauged rivers in various parts of England, Wales, and Scotland, and have no hesitation in calculating the minimum flow upon the basis of one-fourth of a cubic foot per second for every 1000 acres. Taking the acreage of the watershed at 200,000 acres, I should say from 25 to 30 million gallons a day would be the minimum flow. I do not know enough of this district to say that the water proposed will be the best; but I saw all the streams, and have no doubt whatever that the water from the Lune and Balder will be good water. I think those streams will afford an ample supply of excellent water for Stockton and Middlesbrough and the intervening districts.

Cross-examined by Mr. SOMERSET: I am not the engineer for this bill, but was down in the district in the autumn of last year to examine into the scheme. I went over the sites of the reservoirs, but I did not go below Barnard Castle, as I did not think it necessary. If you cannot get the gauging you must take the flow of the river by analogy. I do not think you could have taken a gauging since the proposition for this bill, because I do not believe you could have got a minimum flow. There would have been no difficulty in ascertaining it last summer, but it would not have been a fair test, because it was very wet all last year. Of course you could gauge the river any day, but that would not be of any use for the purposes of this bill. What is wanted is the minimum flow. We did not think it necessary to ascertain the full flow. I speak from my experience of other districts of a like character, amongst them that of the Newcastle and Gateshead Water-Works. The district of their watershed is from 10,000 to 15,000 acres in extent. Of course, that is different from 200,000 acres, but it has similar features. I do not speak simply from my experience of that district, but from gaugings all over the country. I do not consider Loch Katrine a similar instance, because the amount of rainfall there is nearly double what it is here. The rainfall gives you no positive indication of the flow, as the land is sometimes absorbent of, and sometimes impervious to it. In the Manchester district the rainfall is greater

than here. The area there is exactly 18,900 acres. I cannot give you a district of 200,000, nor even of 70,000 acres, from my own experience. The area of the Halifax district is 6000 or 7000 acres. There are something like two million acres in the Thames district. Speaking from my experience in gauging streams, I should say you might make an analogy between the Thames and this district. I am aware that the Duke of Richmond's commission gave power to the water companies to take 100,000 million out of a minimum flow of 350,000 million gallons.

Re-examined by Mr. BROWNE: I consider analogy a proper mode of calculation in the absence of gauges. There is no use gauging a flood, and there has not been an opportunity since June, 1875, of ascertaining the minimum flow in a dry season. Glasgow is not an analogous case to Stockton, but Newcastle and Gateshead is, the chain of hills being the same. I calculate the minimum fall of rain in a dry season at 30 inches in the Tees district.

By the COMMITTEE: None of the reservoirs can be made in less time than six years, on account of the height of the embankments.

Mr. *Thomas Fenwick*, examined by Mr. MICHAEL.

I am engineer to the Hartlepool Water Company, who have both pumping and gravitation works, the source of the supply of soft water being near the head of the Skerne. I am engineer to the Airedale Drainage Commissioners, and know the Stockton and Tees district. The water of the Tees, generally speaking, is good for all purposes; but when the flow is small it must, owing to the sewage, be unfit for drinking. I have seen the sewage and tan works draining into the river at Barnard Castle, and this must be very bad in dry weather. The minimum flow at the pumping-station in dry seasons will not be more than 23 million gallons. I have seen Dinsdale Dam quite dry, and the mill was stopped in April last year, and what water there was came through the fish-pass. I have observed the river at Yarm this year, and seen gravel-beds exposed near the bridge, which I never saw before. The average rainfall in the Hartlepool district, at Hurworth Burn and Hartlepool, for seven years, from 1869 to 1875, was 29·20 inches, and the minimum was 19 inches, or two-thirds of the average. I have found a similar average in Yorkshire, where I live. To take a quarter of a foot per second would give 27 million gallons passing the pumping-station; but I am satisfied it is as low as 23 millions per day sometimes, and to reckon 9 millions would be taking one-third. Darlington pumps about 6 million gallons per day, which must be added. I do not think so much ought to be taken, as that gives nearly half the total flow of the river. There will be about a pint of sewage to 25 gallons of water passing the pumping-station, and that will be 1 part in 200. I think the time has arrived for storing the flood water in the upper reaches of the Tees, as that will allow 9½ million gallons per day to be sent down in addition to the dry weather flow. The soil is not polluted by any surface drainage, and the water appears to be remarkably pure. A minimum flow of 15 cubic feet per minute per 1000 acres is to be had there. At times the rainfall would be so large as to fill the Lune reservoir in 21 hours. That is from gauges I have taken on 5¾ cubic feet per minute per acre. I have known it on our own watershed, and the rainfall is more at Stockton than near the Tees mouth; therefore, the maximum will be more than I have given. I estimate the average rainfall will be 42 to 45 inches, and the minimum 30 inches, or two-thirds of the average. I think 16 inches of that will be the available flow. The supply would be 19 million gallons per day from the Lune, and 10 million from the Balder. The usual compensation is one-third, which will give 9½ million gallons per day to be sent down as compensation. The minimum summer flow is 4 million gallons, and the average for the summer 6 million gallons per day. The reservoirs will hold 160 days supply, and therefore it is proper to reckon the minimum flow for that period. It is proposed to send down 8 million gallons per day for towns supply, and storeage will be required for 1840 million gallons. The total provided is over 2000 millions, which is sufficient for many years to come. Darlington will receive benefit instead of being damaged by these works, as they will have 5 million gallons per day more than at present flowing down the river in dry seasons, when alone they could be affected. The sites for the three embankments could not have been better selected, and the estimates are quite ample to complete everything.

Cross-examined by Mr. SALISBURY: The effect on the properties will be to cause some injuries to the landowners, but nothing exceptional. Of course, if all the water is taken from a stream running through land, it will injure the estate; but that will not be the case here. The pipe to be laid during the construction of the reservoir will not cut off the supply from the mills, except for six months, near the completion of the reservoir. It is intended to have a fish-pass at each of the reservoirs, and I think they are admirable for the purpose.

Mr. SALISBURY: Do the people of Darlington, Stockton, and Middlesbrough suffer in health from the healthy sewage poured into the Tees?

Witness: I do not know; it would depend upon the quantity of sewage in the water. I have made an estimate, and find 100,000 gallons a day flow from Barnard Castle, and 35,000 gallons from the other places.

By Mr. LITTLER: If there is anything in the theory of water being purified by tumbling about, the Tees is just the river for it, having a gravelly bed and boulders down as far as Darlington. I observed the minimum flow of the river last spring, and it was then, I think, less than I have estimated it from actual gaugings. I should think the minimum I have spoken of will occur at least once in seven years, and will last for a month. I found it so in 1868, and again in 1875. There is very little difference in the minimum flow of any district, whether the Tees, or the Thames, or the Halifax district. The only disturbance will be where there are many streams. The soil in the upper part of the Tees district is of a moist, peaty nature, and that is likely to increase the flow. For two days in 1868 the flow from 3458 acres was at the rate of 6½ cubic feet per minute per 1000 acres on the Skerne. I am sure the deposited estimates are quite sufficient, and a large margin has been allowed by Mr. Mansergh. I believe the actual cost will not be so much as the estimates. At Hartlepool we pump from the limestone rock for the domestic supply, and gravitate the rainfall for trade purposes.

By the COMMITTEE: If water is taken before the reservoirs are completed, it must certainly be by an arrangement between the corporations and the mill-owners, for there is nothing in the bill about it.

Mr. *Richard Cail*, examined by Mr. BROWNE.

I reside near Newcastle-on-Tyne, and am an Associate of the Institution of Civil Engineers, a member of the Tyne Commission, and have been Mayor of Newcastle. I have known the Tees for many years, and have seen it in all conditions—both flood and dry. When it is in flood it rises very rapidly, and comes down with considerable force; but it falls as rapidly as it rises, and runs very low indeed. It is generally dry in July and August. I have been frequently at Dinsdale, the dam there being 6 feet 1 inch wide, and not more than 18 inches deep. The flow would not be more than 26 to 28 million gallons a day. The mill takes about 20 million gallons, and the fish-pass eight million gallons, when there are three inches of water on the dam; but I have frequently seen the dam quite dry, and walk over it, so that the flow could not then have been more than 24 million gallons per day. Dinsdale is below the pumping-station, and the Skerne and the Clow Beck have fallen into the Tees, so that the flow at Tees Cottage will be less than at Dinsdale. I consider the estimates for this scheme quite sufficient. I have an opportunity, as a Tyne Commissioner, of forming an opinion, as we are making a dock in the hard boulder clay, in which the cost of excavation is less than that provided for by Mr. Mansergh.

Cross-examined by Mr. SALISBURY: The fish will be able to get up to any height by the proposed fish-pass without any difficulty, for they would rise gradually. The cost of the passes will be £2 per foot. If passes of this kind were common, salmon would be enormously increased. When the water is below the top of the dam the pass is dry, but the pass can be taken into the river itself. Dinsdale is, by the river, about 11 miles from the company's intake. The water above the intake will, of course, be more before the company have abstracted any.

By the CHAIRMAN: There are two streams, the Skerne and the Clow Beck, which come into the river between the pumping-station and the dam. Salmon will always take the flood both for going up and coming down a river.

Mr. *George Wilson Stevenson*, examined by Mr. BROWNE.

I am a civil engineer, and have designed and constructed many water-works, both for pumping and gravitation. I have visited the Tees district, and considered the corporations scheme, which I think an undeniably good one. The gathering-grounds are admirably adapted for the present and future supply, and free from all contamination whatever. If the district increases, additional reservoirs can be constructed; but those in the plans are sufficient for some time to come. The compensation water to millowners is quite sufficient; and, as they do not oppose the bill, it is an indication that they are satisfied. The water company's proposal to pump more from the river is undesirable, for it would then become additionally foul at the intake, and become increasingly difficult to provide a pure supply, thus involving increased cost for filtration. I also think it is undesirable that the supply of water from the river should be increased, or even continued, as it is most desirable that pure water should be supplied for domestic purposes. I think, when water can be got from hills, it should never be taken from rivers. If this scheme were carried out, there would be 50 per cent. more water to pump from, at Tees Cottage, than there is now. I think the sum proposed to be paid to the company is fair, and if it be not, the amount can be settled by arbitration.

Cross-examined by Mr. SUTTON: If a stream is very rapid, and a very short time elapses between the point of discharge of sewage into, and that at which the water is drawn off, there is not sufficient time to oxidize the sewage. No doubt the process of oxidation is helped by the running of the water over boulders and stones, as in the Tees. I would rather pay double or triple for good water than for bad. I do not know that Tees water is better than the Thames, but I would rather drink any water than that of the Thames; and if I were living in Middlesbrough, I would be quite prepared to pay an extra rate.

Re-examined by Mr. BROWNE: I do not think, if the sewage arrived at the pumping-station within two hours of its finding its way into the river, it could be oxidized. I think it would be quite impossible.

The CHAIRMAN: When you say that the sum proposed to be paid to the company is a fair one, are you aware that it is limited to 25 years purchase?

Witness: I was not, and I do not think that there ought to be such a limitation.

Mr. BROWNE said it was not intended to insist upon such a limitation in case of reference to arbitration; but whatever was considered the value of the works, it would be in the power of the arbitrator to award.

Mr. *Alexander R. Binnie*, examined by Mr. BROWNE.

I am a member of the Institution of Civil Engineers, and a Fellow of the Geological Society. I have had large experience since 1859, both in England and India, in connexion with water-works. I have given considerable attention to geological questions in connexion with water supply. I am engaged at present as water engineer at Bradford, and am carrying out extensive alterations in the existing works. I remember, in 1854, in connexion with the Bradford Water-Works Bill, the Parliamentary Committee, in sanctioning the scheme of the company in preference to that of the corporation, intimated that it would be better that the management of the works should be in the hands of the corporation, and it was so arranged. I have inspected the district which it is proposed to supply by this scheme. The geological conditions are very similar to what they are at Bradford, and the scheme is, in my opinion, a quite practicable one.

Cross-examined by Mr. SALISBURY: I have examined the estimates in this case, and consider them fair. The geological conditions of the district are similar to what they are at Bradford. I believe there have been several instances in which corporations have purchased the works of water companies, but I do not know whether it has been done compulsorily. Some of the companies have been unwilling at the outset, but it has ultimately been accomplished. I do not know what water the community comprised in this scheme will consume, nor what the probable dividend on the outlay will amount to.

Re-examined by Mr. BROWNE: I regard the estimates of Mr. Mansergh as ample.

By the CHAIRMAN: In the case of Bradford the corporation and the company introduced new bills in 1854, and as in this case they were to be supplied from different sources, but eventually the corporation adopted the source of supply of the company. There would be a large saving of expense by having settling-beds at Stockton for the sewage instead of being obliged to put the water through the process of filtration.

Mr. *Edmund Easton*, examined by Mr. MICHAEL.

I am a member of the Institute of Mechanical Engineers, and have had a large experience of water-works. I have been engineer of the Brighton Water-Works since their formation. In 1872, the corporation there purchased the works of the existing company, and since that time the supply has been much cheaper and more efficient than it was before. In Birmingham, last year, the corporation took over the works of the company, and they are now putting upon their books poor houses, at the rate of 150 per week. It is much easier to enforce the consumption of pure water where the supply is in the hands of a corporation, than when a company have the management. After the Birmingham Water Bill was passed into an Act, the corporation consulted me as to what would be a proper sum to pay to the company for their works. In my report I said that, in considering the price to be paid, the value of the land must not be lost sight of, and the probable increase in its value must be taken into consideration. The amount of water required for the supply of Birmingham was eight million gallons, and the whole machinery was included in my estimate of the value of the works. The conditions there were much more favourable to the company than they are here. One would have thought that what satisfied Birmingham would have satisfied Stockton, if they had been reasonable men. The 25 years purchase was a full and fair compensation for Birmingham, and would be more than that for Stockton. I believe that, sooner or later, it would be necessary for the company to go to a new source of supply; and every year that the transfer to the local authority is delayed, it will make it the more expensive. I have studied Mr. Mansergh's plan, and think it is a good one, for it deals with the upper sources of the river in the way in which every river in the kingdom ought to be dealt with—by storing the flood water for dry seasons. The quality of water is the same as that down below, and is free from pollution; therefore, it is better water. I think Darlington ought to join in the scheme; and, if the arrangements in the bill are not what they like, I have no doubt some other could be made. So large a proportion of the dry weather flow of the Tees as the company propose to use cannot be abstracted without detriment to the population below their intake. The corporations scheme will send down more water than is got at present. I agree with the estimates generally.

Cross-examined by Mr. CLARK: I should say the compensation water is not deteriorated in quality. Some of the hills of the Tees Valley are peaty, but I cannot say whether the storing of such water makes the rest peaty when delivered. I have not visited the Darlington works.

By Mr. LITTLER: I think where a corporation are of a sufficient standing to make it certain the water-works will be properly managed, it is well to compel a company to sell them the works on fair terms; and I also agree with the law which

allows local authorities to compel the owners of small tenements to have the water laid on; but I do not think they like to put the law in force in that respect. I think Liverpool is happy in its water supply from the corporation, although some want to get another supply. I advise the Ramsgate Water Company, having been their engineer for 40 years. This year they went for a bill to obtain a further supply, and the Ramsgate Local Board deposited a bill for compulsory purchase. The company withdrew their bill, and the committee threw out that of the local board; but the evidence showed that there were such shortcomings on their part, that I was convinced they ought not to be entrusted with the supply. I think the two corporations at the foot of this district should have the control of the supply; and I think those above will fare just as well. I did not know before that they propose to charge more for water outside the boroughs.

Re-examined by Mr. MICHAEL: In Ramsgate there is a pure supply of water from the chalk, and it is not contaminated with sewage.

This concluded the case on behalf of the corporations.

(To be continued.)

Legal Intelligence.

EXETER PETTY SESSIONS.—FRIDAY, APRIL 21.

(Before Mr. J. E. C. WALKEY, Chairman; Col. CHICHESTER, and Messrs. BARNES, MILFORD, SANDERS, and KEKEWICH.)

ALLEGED NUISANCE AT THE EXETER GAS-WORKS.

The Exeter Gaslight and Coke Company appeared to a summons taken out by the Exeter Town Council, acting as the urban sanitary authority, which charged that "the building and premises of the said company, situate near the Basin, in the parish of St. Thomas, in the county of Devon, used by them for the manufacture of gas, causes an effluvium, and is a nuisance and an injury to the health of the inhabitants of the district of the said urban authority, and has been so certified to the said urban authority by ten inhabitants of the said district."

Mr. BUCKNILL appeared for the prosecution, and Mr. G. LEWIS for the defence.

Mr. BUCKNILL, in opening the case, said he was instructed to appear on behalf of the corporation of the city, acting as the urban authority, to bring before the bench a nuisance, said to be caused by the gas company in the manufacture of their gas, by their allowing certain effluvia to escape into the atmosphere of the city, causing a great annoyance to the inhabitants, and being injurious to health. The section of the Public Health Act under which they proceeded was the 114th, which provided that where any manufactory, building, or place used for any trade, business, or manufacture causing any effluvia, was certified to any urban authority by their medical officer of health, or by any two legally qualified medical practitioners, or by any ten inhabitants of the district of such urban authority, to be a nuisance or injurious to health, the authority should direct a complaint to be made, and summon the offending persons to appear before a court of summary jurisdiction. On the court being satisfied that the effluvia caused a nuisance injurious to health, the offending parties should be liable to a penalty of £5, "unless it be shown that such person has used the best practicable means for abating such nuisance, or preventing or counteracting such effluvia." The gas company's works were outside the district of the city sanitary authority; but the 115th section provided that they might proceed just as if they were in their district, providing that the summary proceedings were taken in a court having jurisdiction in the district where the house, building, manufactory, or place was situated. The facts of the present case were shortly these. A large portion of the city of Exeter, especially that part situated about Colleton Crescent, had been for several years suffering from a most horrible stench. What the stench was he could not, as a matter of fact, say at the present moment; but he could state that the stench came from the company's manufactory, that it had been traced to those works, and he should be able to show that it was injurious to health, and, in point of fact, that it was poison. He believed he should be able to satisfy the court that the smell was that of sulphuretted hydrogen, an impurity necessarily produced in the manufacture of gas. The reason he had for saying that the smell was that of sulphuretted hydrogen was, that it resembled the fœtid odour of rotten eggs, and the smell of sulphuretted hydrogen was so described by authorities; its chemical composition being one part sulphur and one hydrogen. This sulphuretted hydrogen was necessarily thrown off as one of the impurities of the manufacture of gas, but it might be arrested and destroyed with great facility. The best means known to science for arresting sulphuretted hydrogen was, he believed, oxide of iron; and if this was used, and the works properly constructed, there was no reason why any one should be annoyed by the escape of the impurity. Supposing it was not sulphuretted hydrogen, he should still be able to satisfy the court that it was some noxious vapour escaping from the gas company's works; and that it was so noxious and hurtful to the inhabitants in Colleton Crescent that it had positively caused vomiting, faintness, and sickness on the part of some of the residents, and that police-constables sent on this beat had also been rendered ill. The smell was intermittent, making its appearance early in the morning or late in the evening. It was utterly impossible to suppose it could escape from the company's works by accident, and he should be able to satisfy the court that it escaped because the company did not take the means they should to arrest this vapour. It had been said that the Town Council had not done what they should have done in this matter, that they had been asleep, that they had taken proceedings long after the proper time; in point of fact, that they were parties to allowing this nuisance to go on unchecked. But it would be seen that, under the section of the Act he had read, it was not for the council to fish out a case of this sort and set the law in motion—they themselves must be put in motion by some one else. Supposing the council had set some of their legal officers at work in the matter, it was just possible that the inhabitants might have come forward and said, "So far as we are concerned, we do not consider ourselves justified in making the complaint which ten of us could do by Act of Parliament." Some six months since, there was a proposition made to the gas company by the council to purchase the establishment, and it would have been a matter of ill grace to have gone forward at that moment with a prosecution, as it would, of course, have been said that the council took this action with a view of depreciating the value of the works they were seeking to purchase. But when a complaint was made by ten inhabitants in accordance with the Act of Parliament, proceedings were at once taken. With regard to the case now brought before the bench, he should confine himself to two points. He should prove the existence of the smell—or, if he might use a stronger word, the stink—and he should satisfy the bench, by direct evidence, that the smell emanated from the gas company's works, and that it was injurious to health. When he had proven this, the *onus probandi* would be thrown on the company to show that they had used the best practicable means for preventing and counteracting the effluvia. He should confine himself to evidence of circumstances, and should not call a single scientific witness. When he had proved that there was a nuisance coming from the gas-works injurious to health, he need do no more; but the company must by evidence show that they had used the best practicable available apparatus for preventing the dissemination of this noxious vapour.

Mr. LEWIS asked that a report made by the late Dr. Letheby, in 1870, should be produced.

Mr. BUCKNILL contended that the report could have no bearing on the case as it now stood, as the date of it was some years previous to the date of the present complaint.

After some discussion, it was decided that the report should be produced if the bench thought it desirable.

Mr. *B. C. Gidley*, town-clerk of Exeter, produced the minutes of the Town Council of the 3rd of February, authorizing the present proceedings. In cross-examination, he said the city surveyor was not present, because he had not been over the gas-works for the last six months. There had been a suspicion that the nuisance arose from a sewer, with gully-holes, at the bottom of Magdalen Road; but that was some years ago, and the gully-holes did not exist now. The complaint of the stench had come from other persons besides those whose drainage was carried into this sewer. The river was not generally in an offensive condition; the volume of water was too great for that. The improvement of the sewerage of the city was still under the consideration of the council. He did not know that, on a report the council obtained being presented to the company, they adopted every practical suggestion, and spent £1500 in adopting means to remedy the supposed nuisance.

Captain *C. A. Thompson*, R.A., said he went to reside in Colleton Crescent on the 19th of January last, and almost on the first day he arrived there he experienced a most offensive smell. The first time he noticed it was in the morning. His house overlooked the gas-works, and completely looked down on them. He ascertained that the smell never came unless the wind blew direct from the gas-works, and he noticed that the smell was always accompanied by a bluish-white vapour from the engine-house chimney on the works. He had experienced the smell on innumerable occasions. Speaking generally, he had smelt it at intervals at all hours in the day, when the wind was blowing in that direction; but it had been worse between nine and ten o'clock at night than at any other time. The effect of the smell was to give him a catching sensation in the throat, and his impression of it was that of rotten eggs. On two occasions the smell had caused nausea and violent headache, which lasted for several hours. At his own house the smell had constantly made him feel ill; he had frequently awoke in the middle of the night experiencing the smell and feeling ill from it, when he had gone to bed perfectly well. On these occasions he had received frequent complaints of the smell from other persons in the house. On the occasion of his first visit to the gas-works, in company with Mr. Cuthbertson, one of the directors, he smelt nothing offensive. Within two hours of his return home, however, the smell returned. On his second visit he experienced a smell near the engine-house; and on the third, on Friday, April 7, there was an awful stench surrounding the asphalte-works, situated on a piece of ground just outside the gas-works, and near the engine-house. He then went away with the impression that the smell came from the asphalte-works. Between 10 a.m. and 8 p.m. on Sundays, whilst the wind was away from the gas-works, he generally experienced no smell. On Sunday, April 9, at 9.15 p.m., however, the wind changed, and there was then a bad smell. On visiting the works, he traced the smell close to a wall dividing the gas-works from the asphalte-works, more especially at that corner near the engine-house. He mounted a ladder, and got on the partition wall, and the stench from the asphalte-works being apparently very bad, he went away, still thinking it proceeded from these works, although he did not think the process carried on there sufficient to account for it. On Tuesday, April 11, the wind being north-west, there was no smell all day; but at 8.30 p.m., the wind having got round to the west, he experienced a strong smell. On visiting the gas-works, he was there unnoticed for five or ten minutes. He found a terrible stench, arising more especially from the corner where the shaft of the engine was working. On mounting a ladder and getting on the partition-wall between the works, he found that the smell did not come from the asphalte side. The wind was beating down upon him from the engine chimney at the time, and the stench coming from it was very bad. His presence was now noticed by a man on the works, and, curiously enough, from this time the stench decreased. He then went into the asphalte-works, and turned over a heap of burning stuff there, but he found no offensive smell coming from it, except in one corner, and then there was only a slight smell. He afterwards clambered up and looked over into the gas-works, and still traced the stench to the corner close to the engine-shaft, which was at work, although by this time the smell was much decreased. His gold watch-chain was turned nearly black from the stench, and the result of this visit convinced him that the smell did not come from the asphalte-works. On Saturday, the 15th, he was in a line behind the gas-works. The wind was nearly due north, and away from Colleton Crescent. On getting into the line of wind he caught a slight smell of gas, followed by a whiff of the rotten egg smell, which went away for a short time and then returned. There was no other manufactory in the neighbourhood except the asphalte-works, which he had previously visited and found free from smell. On Sunday, the 16th, he went to the same lane, and experienced a similar smell. On the following day, at 9.45 p.m., he again visited the works, accompanied by Mr. Gordon Cumming, and his servant. It was a pouring wet night and pitch dark. He took with him a test paper, prepared with acetate of lead, and the effect of sulphuretted hydrogen on this would be to turn it dark brown, and, if strong enough, black. He first went into the asphalte enclosure, but no smell was coming from the heap there. On his going on the other side into the gas-works, he immediately experienced a very bad smell. By means of a pole, he placed his test-paper over the top of a chimney, from which smoke and vapour were issuing. He had some difficulty in doing this in consequence of the rain. The test-paper was nearly reduced to pulp, and, on examining it when he got home, he found it much stained. It was perfectly white when he started, and the discoloration was that which would be produced by sulphuretted hydrogen. On the 19th the stench from the gas-works was horrible. His house was full of it, and, on going to the works, he heard the crank of the engine at work, which was invariably the case when the smell was so bad. On the previous evening he went to the gas-works with his servant and a man named Dormand, previously in the employ of the gas company, and placed test-paper on the division wall between the gas and asphalte works. The stink at the time was very bad. He also placed his testing apparatus close to the top of the chimney, and the result was that there were traces of sulphuretted hydrogen found on the paper. He had constantly passed the spot where the Larkbeare sewer emptied close to the Ballast Quay, but he had never experienced any bad smell from it.

Cross-examined: The asphalte works, from which he at first thought the smell came, belonged to the Town Council. From the heap of stuff on these works he had noticed a white bluish vapour, which at times emitted a slight smell of sulphur, but very different from that complained of. To the best of his belief, the most offensive stench arose from the smoke and vapour which issued from the chimney of the gas-works, although he had experienced smells on other parts of the premises. On Sunday, when the smell was very bad, the barometer was very low, but he was not aware, although it was, no doubt, a fact, that when the barometer was low, the smells arising from sewers were worse than on other occasions.

Re-examined: He had perceived the smell at all times, when the barometer had been high as well as low. When he had detected the smell inside his house, on going outside he had invariably found it there as well.

W. Barling, servant to the last witness, gave corroborative evidence as to the offensive smell.

Mr. *F. W. Jones*, residing in Colleton Crescent, said he had frequently noticed the smell since he went to reside there in December last, when the wind blew from the direction of the gas-works, and the smoke was coming from

their chimney. On the previous evening his wife and a lady staying at the house were made extremely ill by it. He visited the gas-works on two occasions with Captain Thompson, and was convinced that the smell did not proceed from the asphalte-works, because he had the tar stirred up, and there was no offensive smell from that—only the ordinary smell of burning material. When he first thought the smell came from the asphalte-works, the wind was blowing from the gas-works towards the asphalte-works. He had never experienced any sewer smell.

Mr. *Cashford* said he had lived at Friars Walk for seven years, during which time the stench had been dreadful. It was like the smell of stale gas-water and rotten eggs, and he always experienced it when the wind blew towards his house from the gas-works. He never thought the smell came from the asphalte-works. The effect on him and on persons in his house was nausea, and in some cases diarrhœa. The smell had never come from the sewer; it had come down the chimney of his bedroom in the middle of the night.

Cross-examined: His belief was that the smell came from the engine-chimney of the gas-works. His reason for saying this was, that on every occasion when he experienced the smell, a vast quantity of stuff came from this chimney. He had observed a fine vapour arising from the dense volume of smoke, and separating from it. Before the removal of Hicks's factory chimney he traced the offensive smell to that, but now the stink came from the gas-works instead.

In re-examination witness stated that he had lived in the neighbourhood for 30 years, and had never experienced any smell from the sewers.

Marian Fey, a nursemaid, in the service of Captain Thompson, gave similar testimony, and said the smell sometimes made her faint.

Mr. *H. G. Cumming*, house surgeon at the Devon and Exeter Hospital, said he had experience of the smell, which was that of sulphuretted hydrogen, and had a tendency to produce nausea. It was injurious to health. He had smelt it while walking on the lawn at the back of the hospital.

Cross-examined: All decaying matter might throw off sulphuretted hydrogen more or less. He knew that the Larkbeare sewer ran in the direction of the back of the hospital, but he had never heard complaints of sulphuretted hydrogen being thrown off from it.

Mr. *A. Greenhill* said he had attempted to trace the origin of the smell for years, and his belief was that it proceeded from the gas-works. He was familiar with the smell of both gas and sewage. Sulphuretted hydrogen was evolved in the production of gas, and he believed it was the smell of this, and not of sewage, that had been so frequently experienced.

Mr. *C. Pinn*, architect, residing at Friar's Green, said he had constantly perceived the smell, almost daily. It was sulphuretted hydrogen, and he was positive it came from the chimney of the exhaust-engine on the gas-works. It was ridiculous to say it came from the Larkbeare sewer. Hicks's factory used to give off a bad smell; but the smell now was not so bad as then. He perceived the smell when the blue vapour proceeded with the steam from the chimney.

Cross-examined: They could sometimes tell when the smell was coming, as they would perceive the vapour coming from the chimney two or three minutes before. He did not know that the ammoniacal liquor was worth £1500 a year to the gas company; he had heard they were selling it for £70 a year. He was acquainted with the drainage of Exeter, and thought there was more complaint about it than there was occasion for.

Mr. *G. A. Townsend*, 9, Friar's Walk, said he had also perceived the smell, and agreed with the description of it given by the other witnesses. To the best of his belief it came from the gas-works. He had taken steps to ascertain this, and the result of this was the conclusion which he had just stated. The smell was very bad, it was not of the kind that was likely to come from a sewer at all. It had been the cause of much illness in his family; his wife had fainted twice from the effect of it. On a subsequent occasion, when the vapour was beating down from the chimney, he had perceived the smell, and a third visit to the vicinity of the works confirmed him in the belief that the smell came from the works.

Cross-examined, witness said in 1872 he wrote a letter at the request of Messrs. Daw and Son (solicitors of the gas company), in which he stated his belief that the smell came from the ammonia-works; but he meant then to further investigate the matter.

Several police officers, who had been on duty in Colleton Terrace and the neighbourhood, deposed to the presence of the smell complained of, and said it had made some of them sick and ill.

Mr. *T. Dey*, a member of the Exeter Town Council, living in Magdalen Street, described the smell as horrible and poisonous, and a ruination to the neighbourhood. It was so bad that he had not been able to sleep all night many times on account of it. It was not like a sewer smell, but that of dirty gas water. He had satisfied himself, by personal observations, that the smell came from the gas-works.

Cross-examined: Last Wednesday night the smell was very horrible, and he should have liked to have fixed the whole of the gas company where he smelt it all night. Though not perfect, the drainage of the city was not half so bad as made out.

Mr. Lewis: That's what we say of our gas-works.

Mr. *Lake*, in the employ of Mr. Jones, of Colleton Terrace, gave corroborative evidence.

Andrew Dormer said he was now in the employ of the Town Council; 12 months ago he was in the employ of the gas-works. He worked there six months, and left because the work did not agree with him. He went with Captain Thompson and showed him where to put the test-paper. The smell which he experienced when with Captain Thompson was the same that used to come from one of the taps in a pump near the engine-house. Last night that tap was gone. The company never let him into the secret as to what they did with the ammonia water. The smell was similar to what the witnesses had described it. There was some gas tar there which was purchased of the gas company.

Cross-examined: He did not know that the ammoniacal liquor was sent away in tank-trucks to Plymouth; neither did he know that the tap on the pump was placed there to let off the waste water from the engine.

Mr. *C. Bradshaw*, of Bristol, proprietor of the asphalte-works, said it was not true that any smell arose from them. There was no more smell from asphalte than from any other mineral. The nausea and other symptoms of sickness mentioned were not caused by any process on his works, because there was nothing there got up to any heat which would throw off an offensive gas. There was some gas tar on his works which was purchased of the gas company.

Mr. *R. Sanders* said he could speak of the Larkbeare sewer from 1824 up to the last few years. He had never detected any smell from that sewer, and could swear most distinctly that he had never known any offensive smell coming from it. He was a member of the Old Improvement Commission, and therefore had some knowledge of these sewers. He used to keep a boat on the river, and had had opportunity of seeing where this sewer emptied itself, and he could state that, to his knowledge, this sewer never caused any offensive smell.

This was the case for the prosecution.

Mr. Lewis, on behalf of the gas company, raised several technical objections. The first was that the smell complained of was not a nuisance within the meaning of the Act; secondly, that no proceedings could be taken against the company, unless it was proved that there was negligence in carrying out its statutory powers; and thirdly, that the company was not liable, because it had not been shown that the effluvia alleged to come from the engine chimney were caused in the process of manufacture.

The Bench having overruled these points,

Mr. Lewis proceeded to address the bench on the merits of the case. He said he was not sorry to address the bench on the merits of the case, but he had felt it his duty to take these objections. He complained that the Town Council had called no scientific witnesses, and commented on the fact that the prosecutors had not put their own surveyor into the witness-box. The gas company were as anxious—possibly more anxious—than the Town Council to find out what was the matter with their works. The directors had not only allowed access to them to any persons at any hour for this purpose, but had invited the council to send some recognized scientific man to inspect the works, and point out any defect. Instead of that, they came into court with the evidence of policemen and gentlemen who, although their evidence was doubtless honest, were not experts. Both the late Dr. Letheby and Dr. Redwood were called in and examined the works, but neither found any nuisance. Dr. Letheby, in his report, condemned Hicks's factory, which existed on the gas-works in 1870, as a nuisance, and it was accordingly removed. In 1874 Mr. Boulnois, the city surveyor, made a report on the matter; and on his recommendation the company expended £1500 in providing new purifiers, and introduced the use of oxide of iron in the purifying process. He (Mr. Lewis) should call scientific evidence to show that the works were conducted in the best possible manner, that the machinery and vessels were in perfect working order, and that there was nothing in the manner in which the process of gas manufacture was carried on at the works to cause an annoyance. He should also show that it was impossible that the smell was that of sulphuretted hydrogen, and that, even supposing this came from the works, the company could not be convicted, because they had used the best practical means to prevent a nuisance. Whether the smell arose from the sewer, the asphalte-works, the blue-works, the hide-works, or any other of those stinking places which existed near the Basin, he could not say. He maintained, however, that it did not come from the gas-works, and on these grounds—that it was impossible the smell came from the works, and that the company had used every means to prevent a nuisance—he claimed to have the summons dismissed.

Mr. *William Stansfield*, resident engineer at the gas-works, said he had had a long experience in gas-works in the north of England. The Exeter works were good, as was also the process of manufacturing gas there. Free access had been given to persons to examine the works, but nothing offensive had been traced that he was aware of. Nothing but steam and smoke went up the chimney mentioned, and there was no reason for stating that ammoniacal vapour went up. All the ammoniacal liquor produced was removed from the yard in covered tank-trucks, and sent by rail to Mr. Hicks, at Plymouth. The liquor was a valuable commodity, and was not a thing to be wasted. It was pumped direct from covered pits into the tanks. He was sure smells arose from the asphalte factory; he had often observed a blue vapour from the heap on these works. When he conducted persons over the gas-works he had made no alteration in the process, or in any way prepared for their visit. There was no possibility of an escape of gas from the scrubbers; if there was a leakage, it would be immediately discovered.

Cross-examined: The ammoniacal liquor was always contained in air-tight compartments, from the time it was first produced to when it was sent away. Amongst the impurities in the process of gas-making were sulphuretted hydrogen and carbonic acid. The purifiers consisted of six iron vessels—two containing oxide of iron, and the others lime. The sulphuretted hydrogen gas was retained and absorbed by being passed through the vessels containing oxide of iron, and the gas was then passed through lime for the purpose of abstracting carbonic acid. He was prepared to state that the vessels on the works absorbed all the sulphuretted hydrogen in the gas. In his opinion it was not necessary to pass the gas through lime prior to passing it through oxide of iron. Neither did he think it necessary to send it through sawdust saturated with sulphuric acid to remove the ammonia, because this was done in the Exeter Gas-Works by passing it through the scrubbers.

By the Bench: The ammoniacal liquor was sent off about eleven o'clock in the morning, and never in the evening.

Mr. *W. A. Padfield*, secretary to the gas company, said in 1874 he wrote to the Town Council inviting them to make any suggestions, but he had received no reply to that letter, and no scientific suggestion had been made. Owing to the complaints of the council, the company got rid of Hicks's factory at a sacrifice of about £1000 a year for five or seven years. The ammoniacal liquor and tar are valuable products, and would not be thrown under the furnaces. If they did not use lime the consumers would smell the sulphur in their houses. They did not use oxide at the Tudor Street works; that was the old gas-works, and were only used in the winter time. There had never been any complaint about the Tudor Street works.

Cross-examined: Lime was the chief purifier at the Tudor Street works. He had experienced a smell as of rotten eggs from Bradshaw's factory, as clinkers gave off sulphuretted hydrogen. He had never thought of telling the council that, although the gas company were anxious to discover the smell some time ago, the sulphuretted hydrogen did get into the pipes; that was owing to a valve breaking, and would have nothing to do with the complaint now before the court.

John Marks, living at Colleton Grove, and who had worked at the gas-works 35 years, said he had had charge of the retorts, and never saw anything but coke burnt there. Nothing was ever done at the works to cause an offensive smell. No ammoniacal liquor was ever put in the pits under the furnaces.

Cross-examined: His particular duty was in the retort-house, but he went to and fro to the engine-house. Nothing but smoke and steam went up the chimney.

Charles Newberry, stoker at the gas-works, said nothing but the smoke from the coke and the steam went up the chimney. There was a glue factory about 200 yards off, and when the wind blew from the west, he had noticed a very offensive smell come from the glue-works. On his way home he used to pass that way, and he had experienced a most disgusting smell from the glue factory. From where he was living now, he crossed the river two or three times a day, and had noticed an offensive smell caused by the oil on the water that had drained from Messrs. Thomas's stores in the Shilhay. He had also experienced, when the process was being gone through, a nasty smell come from the asphalte-works; and, if the wind was in that direction, it carried it directly across the gas-works.

Cross-examined: It never struck him that the smell complained of arose from the Larkbeare sewer; he had never noticed any smell from it. The smell at Bradshaw's works arose from the clinker and gas-tar heap when it was set fire to, and broken up together. Mr. Bradshaw gets both the clinker and gas tar from the works.

William Featherstone, another stoker, stated that when he worked at the gas-works, 16 years ago, the ammonia-tanks were not covered up, but now they were. He also had experienced a disagreeable smell from the asphalte-works. It was like the lighting of a lucifer match. There was also a disagreeable smell from the hide-works near the Basin.

Cross-examined: The smell from Bradshaw's was not like "rotten eggs."

Samuel Scoines, bricklayer at the gas-works, where he had worked 37 or 38 years, said it was impossible that the smell could come from the gas-works. There might have been some truth in it 25 years ago, but now the ammoniacal liquor was closed up, and everything was carried out on improved principles. When Mr. Dand resided at the gas-works he used to have to close up his windows, because of the smell coming from the asphalte-works, and he got Mr. Bradshaw

to remove it farther away from the house. Witness had also experienced the same sickly smell from the same place.

Thomas Avery, who had worked at the gas-works for 12 years, said there was nothing there to create a stink; but, when passing the oil stores and the glue factory, he had experienced a disagreeable smell.

Cross-examined: The oil stores he referred to were half a mile off, and were only used as stores.

William Mitchell, a market gardener, residing at Spring Gardens, on the Banks, said he had never smelled an unpleasant smell from the gas-works, but he had noticed it coming from the oil stores, and also the hide stores. The gas-works did not annoy him.

Cross-examined: It would require an off wind to bring the smell from the gas-works to his house. Never noticed it coming from Mr. Bradshaw's.

William Long, residing at the Welcome Inn, the nearest house to the gas-works, gave corroborative evidence, but in cross-examination he said he had never noticed any smell coming from Mr. Bradshaw's works.

In reply to Mr. LEWIS, the witness said the dredging of the river had caused a most offensive smell in the summer time.

John Pethybridge, farmer, of Alphington, gave similar evidence.

Samuel Marks, who had worked at the gas-works for 30 years, and did alternate duty with his brother, one of the previous witnesses, gave similar evidence to that of the other *employés* of the company.

Mr. *H. Willey*, of the firm of Willey and Ford, gas engineers, stated that he had examined the gas-works, and found them in good condition and well conducted. It was impossible that anything on the works could cause the smell complained of in Colleton Crescent. On examining the lime which had been recently used he did not find a trace of sulphuretted hydrogen.

Mr. *J. T. Browning*, engineer and manager of the Plymouth and Stonehouse Gas-Works, had examined, at the request of the directors, the works of the Exeter Gas Company, to see if he could find out a nuisance, and failed to discover it there. Nothing could go up the chimney but ordinary smoke and steam.

The BENCH said they were quite satisfied that the chimney had nothing to do with it.

Mr. LEWIS thought that would end the case, because his friends pinned their case to the chimney.

Mr. BUCKNILL said that was not so; he rested his case on the fact that the nuisance came from the gas-works.

Witness, continuing, said the works were equal to those in any part of the country.

Mr. *William Mann*, late engineer to the City of London Gas Company, where he was engaged for 36 years, said he had examined the works of the Exeter Gas Company, and they were conducted on improved modern principles. The ammoniacal liquor was stored in proper vessels, from which there was no escape, and no nuisance could arise from its being removed in the way it was done at Exeter. He approved of the way in which the Exeter Company used its oxides. On Wednesday evening he went down to the Exeter Basin, and there was a bad smell. It appeared to come from the water. It was like stinking water, and not at all like the smell from gas-works; but he did not go to the gas-works to see if the smell came from there. He should not think of going to a gas-work to find such a smell. If the sulphuretted hydrogen were removed by the oxide of iron, it would be impossible to sulphuret the lime; consequently, the lime would be discharged from the purifiers as a carbonate, and devoid of any noxious smell. It would be impossible for such an amount of offensive odour, as spoken to by respectable witnesses, whom he could not for a moment suppose were perjured, to come from so small a gas-work, especially as these were conducted. It was not necessary to send the gas through sawdust saturated with sulphuric acid, if proper scrubber power were used. That was simply a process to compensate for imperfect scrubbing. He did not consider that the drawing of air through the fouled lime to remove the sulphur compounds, and passing them into a furnace, so good as a method patented by him in 1853, where the ventilating medium, as it is called, is passed through oxide of iron, and absorbed or decomposed. He was of opinion that no properly managed works should exhale sulphuretted hydrogen, except by accident.

Mr. *T. W. Keates*, consulting chemist and superintending gas examiner of the Metropolitan Board of Works, said he had had experience in connexion with gas matters extending over a period of 30 years. He had inspected the works of the company, and was of opinion that they were well conducted, and that the modern improvements in gas-making had been fully taken advantage of. He was wholly unable to account for the bad odours complained of; but was quite convinced that they did not proceed from the gas-works. There was no foundation for the allegation that the noxious fumes came from the chimney, concerning which a great deal had been said. There was nothing escaping from that chimney but steam and the products of the burning fuel used in the furnace, as this chimney was nothing more than the chimney of the boiler which supplied steam to the engine of the exhausters. The method of purification, in which oxide of iron was used for taking out the sulphuretted hydrogen, and lime for subsequently removing carbonic acid, was a very good method. Where a gas company were under no restrictions as to the quantity of sulphur, other than sulphuretted hydrogen, which might be allowed to remain in the gas supplied to the consumers, such a method as that followed in these works would provide, if properly conducted, for the thorough purification of the gas, and would not produce any noxious effect during the emptying of the purifiers, as the spent oxide of iron did not give off sulphuretted hydrogen, and the lime would not be in the state of sulphide, but in that of inodorous carbonate. He had had an opportunity of experiencing the bad smell complained of, on Wednesday night, and had taken it at the time for the smell of foul mud, or of mud left exposed by the retreating tide. He was satisfied it was not the smell of anything connected with gas-works. Although he thought that the asphalte manufactory adjoining the gas-works might occasionally produce some annoyance, he believed it was quite insufficient to account for the bad smells so much complained of. He considered that, altogether, the gas-works were very good works, and that they were, at the time of his visit, in good going order.

This concluded the evidence on behalf of the company.

The Bench then retired to consider their decision. After an absence of about seven minutes, the CHAIRMAN and his colleagues returned into court, and the former said: "We have carefully considered the present proceedings, and have come to the conclusion to dismiss the case."

WORSHIP STREET POLICE COURT.—FRIDAY, MARCH 31.

(*Before Mr.* BUSHBY.)

CHARGE FOR SUPPLY OF WATER FOR WATERING ROADS.

THE VESTRY OF ST. LEONARD, SHOREDITCH, AND THE NEW RIVER COMPANY.

This was an application by the vestry for the decision of the magistrate under the 37th section of the Water-Works Clauses Act, 1847, as to the charge made by the New River Company for the water supplied to the parish for road watering. The 37th clause enacts that—"In all the pipes to which any fire-plug shall be fixed, the undertakers shall provide and keep constantly laid on, —unless prevented by frost, unusual drought, or other unavoidable accident, or during necessary repairs—a sufficient supply of water for the following purposes:—that is to say, for cleansing the sewers and drains, for cleansing and watering the streets, &c., &c.; and such supply shall be provided at such rates, in such quantities, and upon such terms and conditions as may be agreed upon by the Town Commissioners and the undertakers, or in case of disagreement, as shall be settled in England or Ireland by two justices, and in Scotland by the sheriff, until, in either case, an inspector shall have been appointed, and after the appointment of such inspector, by the inspector so appointed.

The New River Company's charge for water, for street watering purposes, is at the rate of 1s. per 1000 gallons, with a discount of ¾ per cent. for every complete million of gallons. Against this charge the Vestry of Shoreditch appealed under the above clause, and the appeal was heard on the 25th of February, the magistrate then reserving his decision.

Mr. ROBERT BAXTER appeared for the company, and Dr. ASPLAND for the vestry.

Dr. ASPLAND stated that the parish of Islington and the Board of Works for the district of Hackney were supplied by the New River Company with water for street watering at a fair price—viz., at the rate of 9d. per 1000 gallons, and the complaint of his clients was that the company refused to apply to Shoreditch the same rate as they applied to Hackney. He urged that for domestic purposes, and for street watering, taken together, a larger rental was derived from Shoreditch by the company than from Hackney. He pointed to the 41st section of the New River Company's Act, 1852, and endeavoured to show that there was no good reason why street watering should not be afforded at Parliamentary rates, as the water cost the company no more for street watering than for trade purposes.

Mr. BAXTER contended that the supply for street watering did cost the company more than the regular supply, taking all the year round, and the company were entitled to a higher rate than was provided for by the 41st section of the Company's Act, 1852, inasmuch as, in order to meet the sudden demands of street watering at times when water was most scarce, an amount of capital, equal to about one-twentieth of the whole, had to be invested in works, which lay idle and unremunerative during two-thirds of the year. Allowing only 5 per cent. as interest on this capital, and adding working expenses, the cost of the water could not be estimated at less than 1s. 3d. per 1000 gallons, whereas the company only received an average return of 10d. by the operation of the scale of discount. This scale of discount was in accordance with the general spirit of the company's Act, which indicated that large quantities of water should be supplied at lower rates than small quantities, and it was the large quantity taken by Islington and Hackney, compared with the small quantity taken by Shoreditch, which caused the difference in the price charged, reducing the rate from 1s. per 1000 gallons to 9d.

Mr. *Muir*, the New River Company's engineer, was called to substantiate Mr. Baxter's statement with regard to the cost of water for street watering.

Dr. ASPLAND, in reply, endeavoured to show that Shoreditch, being supplied at a lower level, should pay less than Islington, and retorted that if street watering cost the company more than they gained by it, as Mr. Baxter contended, it would rather be a reason for applying the smaller charge to the parish of Shoreditch, which took the smaller quantity of water, as by such a parish they would lose the least. He then alluded to the £215,427 available for dividends on the company's last published accounts (1874), from which he concluded that a dividend of about 25 per cent. on their capital was paid.

Mr. BAXTER, however, explained that this amount represented the profits of two half years, one being always kept in hand as a reserve, and showed that the company were entitled to a 10 per cent. dividend, but had not as yet quite attained to that rate.

Mr. BUSHBY this day delivered his decision in the case. He said: The first question is whether the scale of prices given in the 41st section of the company's Act, which would reduce the charge to 7½d. per 1000 gallons, applies to parishes. On this point, which, I understand, is about to be submitted to a superior court, and has not been argued before me, I offer no opinion. The second question is, supposing that the scale of prices does not apply, whether the principle of that scale—viz., that prices should decrease as consumption increases—has been rightly adopted by the company. The argument for the parish is that Shoreditch, from its local position, can be supplied at no greater cost to the company than Islington and Hackney are supplied by them, and, therefore, that the charge should be the same—viz., 9d. per 1000 gallons in all three cases. I think, however, that if Parliament had meant this to be the criterion, and that the company were to derive no greater profit from one parish than another, the rule would have been so expressed, or else that some standard of profit would have been laid down. Upon the whole, looking at the smallness of the consumption by Shoreditch as compared with that by Islington and Hackney, I think the company have rightly applied the principle of the scale in the 41st section, unless, indeed, it should turn out that the benefit of the scale itself can be claimed by the parish. Very probably the rate adopted by the company may be favourable for them where, as here, the parish is contiguous to others already supplied; but, on the other hand, it might be unfavourable where a parish was isolated and distant from existing works. Subject, therefore, to the point about to be raised in the superior court, I find that the charge of 1s. per 1000 gallons to the parish of Shoreditch is, at its present rate of consumption, fair and reasonable. Should it be decided that the scale of prices in the 41st section applies to parishes, then, of course, the case can come back to me.

Judgment for the company.

Miscellaneous News.

METROPOLIS GAS SUPPLY.

In consequence of the death of Dr. Letheby, late Chief Gas Examiner in the Metropolis, a somewhat informal report of the quality of the gas supplied by the companies under the legislation of 1868–9, has been furnished to the several companies under the Acts, and to the metropolitan authorities. The following table gives the mean of the results of the daily examinations of the gas sent out from the several stations during the quarter ending March 31. The report, so far as the Imperial Company are concerned, is given for the last time. By the scheme of amalgamation recently sanctioned, that company have ceased to have a financial existence since the 1st of January; but as such scheme had not received the Royal Assent when the results here recorded were completed, the return is made to the Imperial Company. The table shows that the illuminating power of the gas supplied has never fallen below, but has been considerably in excess of, the parliamentary standards. As regards purity, the requirements of the Referees have been fully complied with, except in one instance. Sulphuretted hydrogen was only reported on one occasion during the quarter, and then but a "trace:"—

Companies and Stations.	Illuminating Power in Standard Candles.			Ammonia in Grains per 100 Cubic Feet.			Sulphur in Grains per 100 Cubic Feet.		
	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.
Chartered Company—									
Millbank St., Cannel Gas	22·00	20·00	20·62	None reported.			30·90	12·80	21·45
Beckton, Common Gas	18·30	15·40	16·93	1·80	0·50	0·80	19·00	9·20	12·73
Friendly Place ,,	17·70	16·10	16·61	2·00	0·20	0·16	18·30	7·30	13·73
Ladbroke Grove ,,	17·70	16·00	16·83	None reported.			17·70	10·00	17·23
Imperial Company—									
Bruce Terrace ,,	17·60	14·90	16·23	None reported.			29·60	8·60	11·60
Camden Street ,,	16·60	15·10	15·92	0·8	0·1	0·51	36·10	12·60	20·46
Carlyle Square ,,	16·80	15·10	15·96	0·8	0·4	0·70	23·80	17·00	19·86
Graham Road ,,	18·70	14·70	16·67	0·3	0·1	0·10	17·90	11·80	15·34
South Metropolitan Co.—									
Hill Street, Peckham, Common Gas	17·40	14·40	16·03	1·8	0·2	0·81	30·70	12·2	21·62

Metropolitan Board of Works.

At the usual weekly meeting on Friday last—

Mr. Fowler, in accordance with notice, moved—"That the Board, being of opinion that there should be no further amalgamations of gas companies, without a special Act of Parliament being passed for the purpose, do oppose the clause in the South Metropolitan Gas Company's bill, which would authorize the company to amalgamate with others in the Metropolis." He said the Board, at their last meeting, resolved that the bill of the South Metropolitan Gas Company should be opposed, unless it incorporated the provisions of the Regulations Bill now before Parliament. The South Metropolitan Gas Company were somewhat exceptionally situated, so far as the price at which they supplied their consumers was concerned; and his belief was, that the amalgamation of that company with any other must result in an immediate increase in the price of gas in that district. All he asked now was, that the Board would simply confirm a principle they had already laid down in February, 1875, when they settled the heads of their Regulations Bill—viz., "that no amalgamation between companies should take place without the consent of the Board, and also, where the City is concerned, of the Corporation." He did not propose, however, that the Board should go quite to that extent, but only that no amalgamation should be allowed without the special sanction of an Act of Parliament; and that the Board should appear by counsel before the committee to whom the bill was referred, and have a voice in settling the terms of any amalgamation.

Mr. Dresser Rogers seconded the motion.

Mr. Richardson opposed the motion, on the ground that it assumed that the Board had definitely decided that no further amalgamations of gas companies should take place without a special Act of Parliament, and he held that that principle had never been affirmed.

Mr. Freeman said the question before the Board was whether they were prepared to agree to the proposition that no further amalgamations of the gas companies should be permitted without first being sanctioned by Parliament. At present, amalgamations were allowed with the consent of the Board of Trade. He objected altogether to the motion, and thought the Board should judge of every such scheme proposed on its own individual merits.

Mr. Runtz said there could be no doubt that the object of this motion was to prevent any increase of the price charged by the South Metropolitan Company. In order that that company might not have an opportunity of raising their price by amalgamating with any other concern, a resolution was brought forward to apply to every amalgamation that might be proposed. Surely Mr. Fowler would not object to the amalgamation of any two companies, if the result would be a reduction in price.

Mr. Fowler, in reply, said if the bill was allowed to pass in its present form, they would have full power to amalgamate with any other metropolitan company, and the adoption of such a proceeding could not but affect injuriously the inhabitants of their particular district. If it was the desire of the Board, however, he had no objection to withdraw the motion, with the intimation that he would bring it forward again in another form.

The motion was therefore withdrawn.

Camberwell Vestry.—At the meeting of this vestry on Wednesday last, a discussion arose upon the report of the Finance Committee, which recommended the vestry to vote the sum of £300, on account of expenses incurred in opposing the bill of the South Metropolitan Gas Company. The committee stated that the company had declined to insert a clause in their bill, to the effect, that in the event of an amalgamation with any other company, the charge for gas to the parishioners should not exceed 3s. per 1000 for 14-candle gas. In the course of the discussion several complaints were made of apparently inexplicable increases in the quarterly bills of the gas consumers in this and other districts. One member stated that whatever reductions were made in the nominal price of gas, his bills remained the same; another stated that every reduction in price was followed by an increase in the total amount claimed from him; a third stated that, although he reduced the number of his burners from twelve to one, his gas bill was exactly the same as in the previous quarter; and the chairman (Mr. Turney), to cap all other statements, remarked that having in one quarter consumed no gas at all, he was charged the same amount that he usually paid. Mr. Dresser Rogers, the great gas authority in the vestry, was therefore appealed to for some solution of the enigma. He confessed that he was no chemist, but "he had an idea" that the cause might be found in the improved methods adopted by the companies in the manufacture of gas—"that is to say, a ton of coals was made to produce more gas than it formerly did, and it was hinted that a gas (not illuminating) might possibly pass with the ordinary gas through the meters, and thus cause a larger quantity to be registered than had actually been burnt. Of course, the engineers would possibly laugh at this theory, but there might, after all, be something at the bottom of it." After this explanation the vestry voted the £300 required for opposing the South Metropolitan Company's bill.

Appointment of Chief Gas Examiner.—At the Court of Common Council, on Thursday last, a letter was read from the Board of Trade, announcing the appointment of Dr. Williamson, F.R.S., of the London University, as Chief Gas Examiner, in the room of Dr. Letheby, deceased. The communication was ordered to be entered on the journals, and referred to the Gas and Water Committee.

SINGAPORE GAS COMPANY, LIMITED.

The Annual Ordinary General Meeting of this Company was held at the London Tavern, on Tuesday, the 25th ult.—H. P. Stephenson, Esq., in the chair.

The Secretary (Mr. R. King) read the advertisement convening the meeting, and the following reports and accounts were presented:—

The directors have the satisfaction of reporting continued progress in the lighting of Singapore, for particulars of which they refer to the report annexed, from their engineer and manager, Mr. E. J. Wells, dated Feb. 16, 1876.

The directors going out of office by rotation are—Messrs. Frederick William Collard and Alexander Erskine Stephenson; and these gentlemen, being eligible for re-election, offer themselves for the support of the shareholders. The present auditors, Messrs. William Thomas Morrison and Alfred Williams, retire from office according to the articles, and, being eligible for re-election, offer themselves to the shareholders for that purpose.

The balance-sheet to Dec. 31, 1875, and appended to this report, shows the financial position of the company. The directors have written off for depreciation of works and plant, and off the expenses of first establishment, as per balance-sheet, at the rate of 1 per cent. per annum. The profit for the half year, after writing off these sums, amounts to £2126 2s. 7d., which, together with £27 1s. 1d., the unappropriated profit of the preceding half year, makes the available balance £2153 3s. 8d.; out of this sum the directors recommend the declaration of a dividend at the rate of 7½ per cent. per annum, less income-tax, on the amounts paid up on the preference and original capital; the balance of £102 9s. 7d. to be carried forward to the profit of the succeeding half year.

The dividend to be payable on May 20.

Report of Engineer and Manager.

To H. P. Stephenson, Esq., Chairman, and the Directors of the Singapore Gas Company, Limited.

Gas-Works, Singapore, Feb. 16, 1876.

Gentlemen,—I have great pleasure in again submitting to you the statements of accounts showing the working for the half year ending Dec. 31, 1875.

The progress of the company continues satisfactory. There has been a steady increase in the gas-rental from private consumers and public lamps—say, 1827.51 dols. over the corresponding half year ending Dec. 31, 1874; and for the year ending Dec. 31, 1875, over the year ending Dec. 31, 1874, there has been an increase of the gas-rental of 3704.16 dols. There has also been a satisfactory increase to the revenue on the sale of the residual products over the corresponding half year—viz., 1004.23 dols.

The demand for tar, coke, and breeze, is quite equal to what can be supplied from the works. As most of the other items remain about the same, and everything being fully detailed in the statements of accounts, it is not necessary for me to take up your time any further upon these accounts. I am very glad to be able to state we are now getting over the high-priced coals. This takes much longer to accomplish than it does in England. The efficiency of the works, machinery, and plant, has been well maintained, the buildings being in a good state of repair. The gasholders are working satisfactorily, and all the ironwork, by frequent tarring, is well preserved from decay.

The working in the purifying department still continues satisfactory, and the illuminating power of the gas has been well maintained. The engineer's report will furnish you with all details in the manufacture and distribution departments. The unaccounted-for gas during the half year is 11¼ per cent.

In the carbonizing department, the two new benches of retorts will now shortly be completed ready for use when required. The Nos. 2 and 3 benches of D retorts will be reset as soon as the retorts arrive from England; they cannot now run any longer, having been in use upwards of three years. When these are completed, we shall have no further expenditure in this department for the next three years, beyond the ordinary wear and tear.

The extensions of the mains for public lamps in the town were completed in December last, and during the half year 30 new public lamps were erected, and 20 in the previous half year, making a total of 50 on the twelvemonths. We have now 451 public lamps burning nightly. Orders have been given for five more public lamps; these can be carried out with services within the district of the present mains. I do not anticipate further extensions for some time to come. We have now a wide district, and must utilize our mains by obtaining as many additional lights as possible. Twenty-eight new houses have been fitted with burners, and, with the additional burners fitted to houses already consuming gas, make a total of 284 burners increase during the half year.

The collection of rental during the half year, upon the whole, has been satisfactory, 36,351.62 dols. having been collected and paid to the bank. The arrears, you will note, are in excess of last half year, but this was unavoidable, as some accounts could not be paid until January, after the closing of the half year's accounts. The rates of exchange have been still lower than last half year, the average being only 4s. 1¼d. on bank bills at six months, thus showing a loss on the £4200 remitted of £380 5s.; and, in the present half year, we shall show a still further loss, if present rates are taken for the half year. Upon the £1000 remitted last month, 4s. 1d. only was obtainable, and the present rate is 4s. 0½d. on six months bank bills.

In conclusion, I hope to hear that the general working on the half year has been satisfactory to the directors, and that all the accounts have been found correct.

I have the honour to be, gentlemen, your obedient servant,

E. J. Wells, Manager.

Dr. *Balance-Sheet, Dec.* 31, 1875. *Cr.*

Capital—				Cash at bankers, London and Singapore			
£5 paid on 2000 preference shares	£10,000	0	0		£1,544	17	2
£5 paid on 8849 ordinary shares	44,245	0	0	Ditto in hands of secretary	5	1	5
£4 paid on 200 ordinary shares	800	0	0	Bills receivable	1,800	0	0
£2 paid on 25 ordinary shares	50	0	0	Office furniture	139	14	6
£1 paid on 50 ordinary shares	50	0	0	Cost of works & plant, as per last statement £34,602 14 0			
				Add, extensions during the half year 790 10 0			
11,124 shares	£55,145	0	0		£35,393	4	0
Debenture bonds	6,120	0	0	Depreciation at the rate of 1 per cent. per annum 173 0 3			
Sundry creditors	463	1	1		35,220	3	9
Insurance reserve-fund	56	7	1	Purchase of land	1,118	2	8
Profit and loss	2,153	3	8	Retort account	1,047	14	10
				Meter renewal account	154	15	11
				Stock on hand	8,006	5	11
				Amounts charged to capital for travelling expenses, rent, preliminary expenses, and interest on capital during construction £10,840 5 11			
				Less amount previously written off 580 13 3			
					£10,259	12	8
				Less amount written off this half year, at the rate of 1 per cent. per annum 54 0 0			
					10,205	12	8
				Gas, meter-rental, fittings, and sundries under collection to Dec. 1	1,795	7	2
				Gas, meter-rental, &c., for the month of Dec., and gas for public lamps for the half year	2,635	16	6
				Sundry debtors	123	9	7
				Travelling expenses, suspense account, and sundries	140	9	9
	£63,937	11	10		£63,937	11	10

Profit and Loss Account, from July 1 *to Dec.* 31, 1875.

Coal carbonized	£2,725	7	0	Balance at profit and loss, June 30, 1875	£2,071	14	10
Lime and oxide	19	12	6	Less amount declared as dividend, after deducting income-tax on ordinary and preference shares	2,044	13	9
Trade & general charges	356	17	8		£27	1	1
Rent, rates, and taxes	86	8	1	Gas and meter rental	5,944	17	2
Directors and auditors	205	5	0	Products, profit on fittings, and sundries	1,655	1	7
Salaries and collectors commission	703	14	9				
Wages	349	19	7				
Interest on loans and debentures	254	15	1				
Loss on exchange	380	5	0				
Bad debts and allowances	54	11	3				
Retort account	60	0	0				
Meter renewal account	35	0	0				
Depreciation on works and plant, & expenses of first establishment written off	227	0	3				
Office furniture	5	0	0				
Travelling expenses suspense account	10	0	0				
Balance—profit for appropriation	2,153	3	8				
	£7,626	19	10		£7,626	19	10

The Chairman: Gentlemen, I have now to move—"That the report, with the balance-sheet attached thereto, be received, adopted, and entered on the minutes." I have but very few observations to make. Turning to the balance-sheet, you will perceive that our debenture bonds are £500, and our creditors £2162 less, than in the corresponding half of 1874, our capital having increased by £1140. On the other side, we have cash at bankers and at Singapore £1548 less, so that our financial position is very much the same as it was. Our works and apparatus have increased by £1236. As regards the profit and loss account, our coal payments are much about the same; and we have an increase of a little over £400 on the gas and meter rental, which arises in great measure from an increase in the public lights. Our salaries and wages are £100 more, and trade and general charges £57 more. The only item that at all calls for attention is that of "loss on exchange," which last year was high, and still continues high, and I believe is likely to remain so. We have lost £380 in the half year on this account, equal to a little over 1½ per cent. per annum on the dividends on the ordinary stock. You have, no doubt, seen a great deal in the newspapers lately, chiefly from the chairmen of the various Eastern banks, as

to the causes which have led to the depreciation of silver and the loss on exchange. I have read all these remarks myself very carefully, and the conclusion I have come to is that none of us know anything at all about it. Some people think that the rate of exchange will be lower, others confidently predict that it will be higher, and I am in a sea of doubt and confusion in the matter. I think all we can do is to meet the difficulty fairly as it comes, and, acknowledging that it is an evil, deal with it each half year as it is brought before us. I believe that there are many causes which have operated to produce the high rate; and, looking back for many years, I find, from the statement of the chairman of one of the Indian banks, that for 15 years there has been a profit on exchange, and that for nine years there has been a loss on exchange. He expresses a very strong opinion that exchange will be better, but whether, in his case, "the wish is father to the thought"—seeing that his company have a very heavy capital in India, which they are valuing at the par value of the rupee—is a very great question in my mind. There are no other items in the accounts to which I think it necessary to call attention, and I therefore simply state that our profit is £163 more than it was for the corresponding period last year, and that we are able to pay our usual stereotype dividend of 7½ per cent., and to write off our usual one per cent., which I do not consider a very unsatisfactory result upon the whole.

Mr. FOREMAN seconded the motion.

Mr. RICE asked how many shares were issued last time.

The CHAIRMAN: We proposed originally to issue 1000 shares, but we had applications for 1373. We did suggest to several persons who applied, to reduce the number *pro ratâ;* but there was great unwillingness shown to have any reduction made, and we, therefore, allotted the whole amount.

Mr. GREENE asked how the public lamps at Singapore were charged—whether at per 1000 feet, or per lamp?

The CHAIRMAN said the company were paid per lamp, at the rate of £6 1s. 6d. each—reckoning the dollar at 4s. 6d. The lamps consumed 4 feet per hour for 11 hours per night, for 28 nights each month. A regulator and double tap were attached to each.

The motion was put and carried.

On the motion of the CHAIRMAN, the dividends recommended in the report were declared payable on the 20th inst.

In reply to a shareholder, the CHAIRMAN said the directors proposed to pay off all debentures as they became due. The preference shares could not now be extinguished. The holders had the option of converting them into ordinary shares within five years after their issue; but they did not exercise their option, and, therefore, they would remain preference at 7½ per cent., and no more.

The retiring directors and auditors were re-elected; and, on the motion of Mr. RICE, seconded by Sir W. L. DARELL, Bart., the remuneration of the auditors was increased to 10 guineas each per annum.

The CHAIRMAN: I have now to move the usual vote of thanks to the local committee at Singapore, and to Mr. Wells, our engineer and manager, for their great exertions in carrying on the business of the company. It is an old tale with me to refer to the confidence we feel in Mr. Wells. The more I see of foreign managers, the more I find that when they get abroad they seem to lose their heads. I have had sad experience in this matter, and have found men in whom we had extreme confidence before they left England, act in a manner which has quite disappointed our hopes. It is, therefore, a great satisfaction to me to testify to the way in which Mr. Wells has justified our expectations of him. Of course a board of directors in England can exercise very little control over a concern in Singapore. I have no hesitation in telling you that the great success of this company is mainly due to the manner in which Mr. Wells has managed things in Singapore. He has the interests of this company thoroughly at heart, and he has worked in a most efficient manner. I have, therefore, great pleasure in moving this vote of thanks.

Mr. HULETT: I have great pleasure in seconding it. I knew Mr. Wells many years before he left this country, and it is very gratifying to me to hear that the directors of this company place the same confidence in him now as they have ever done. I have seen him once since he became the engineer and manager, and I can testify that he feels a great interest in the prosperity of our affairs.

The motion was put and carried.

Mr. HULETT moved a vote of thanks to the chairman and directors. He considered that the management of the company had been most satisfactory; very different to many other companies which started with equally good prospects, but had not realized such good results.

Mr. GREENE seconded the motion, which was put and carried.

The CHAIRMAN having acknowledged the vote,

A similar compliment was paid to Mr. R. King, the secretary, who having briefly replied thereto, the proceedings terminated.

THE MECHANICAL ACTION OF LIGHT.

The April number of the *Quarterly Journal of Science* contains a *verbatim* report of the Lecture delivered by Professor Crookes, at the Royal Institution, on the 11th of February, on the great discovery, made by him, of the mechanical action of light. Through the kindness of the learned professor we have been furnished with copies of the diagrams exhibited by him on that occasion, and with their assistance we proceed to give an abstract of his interesting discourse, so far, indeed, as relates to the proposed application of his discovery to the purposes of photometry.

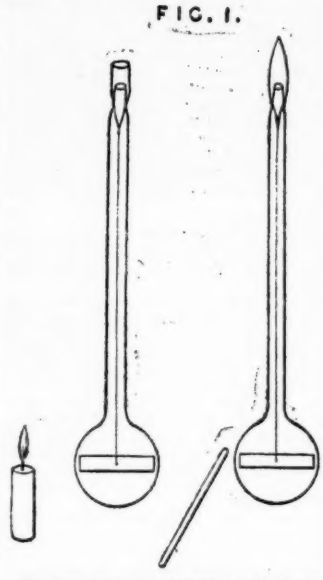
Mr. CROOKES commenced by remarking that to generate motion had been found a characteristic common, with one exception, to all the phases of physical force. If the bulb of a thermometer were held in the hand, the mercury expanded, and, rising along the scale, indicated the increase of heat it had received. Water heated was converted into steam, and moved our machinery, our carriages, and our ironclads. If a loadstone were brought near to a number of iron filings they moved towards it, arranging themselves in peculiar and intricate lines; or if a piece of iron was brought near a magnetic needle the latter was turned away from its ordinary position. When a piece of glass was rubbed with silk, and thus thrown into a state of electrical excitement, pieces of paper or thread would fly towards it, and in a few moments be repelled again. If the supports from a mass of matter were removed it would fall, the influence of gravitation being here most plainly expressed in motion, as shown in clocks and water-mills. If a musical note be sounded near to a stretched string upon which pieces of paper are fixed, some of these papers would be found projected from their places. Latterly, the so-called "sensitive flames," which are violently agitated by certain musical notes, have become well known as instances of the conversion of sound into motion. How readily chemical force undergoes the same transformation is manifested in such catastrophes as those of Bremerhaven, in the recent deplorable coal mine explosions, and, indeed, in every discharge of a gun.

But light, in some respects the highest of the powers of nature, has not been hitherto found capable of direct conversion into motion, and such an exception cannot but be regarded as a singular anomaly. This anomaly, the lecturer believed, had, by the researches he was about to bring forward, been now removed, and it would be found that light, like other forms of force, was capable of direct conversion into motion, and of being—like heat, electricity, magnetism, sound, gravitation, and chemical action—most delicately and accurately measured by the amount of motion thus produced.

My research, says Mr. Crookes, arose from the study of an anomaly. It is well known to scientific men that bodies appear to weigh less when they are hot than when they are cold, the explanation given being that the ascending currents of hot air buoy up the body, so to speak. Wishing to get rid of this and other interfering actions of the air during a research on the atomic weight of thallium, I had a balance constructed in which I could weigh in a vacuum. I still, indeed, found my apparatus less heavy when hot than when cold. The obvious explanations were evidently not the true ones: obvious explanations seldom are true ones, for simplicity is not a characteristic of Nature.

An unknown disturbing cause was interfering, and the endeavour to find the clue to the apparent anomaly has led to the discovery of the mechanical action of light.

FIG. 1.



I was long troubled by the apparent lawlessness of the actions I obtained. By gradually increasing the delicacy of my apparatus I could easily get certain results of motion when hot bodies were brought near them, but sometimes it was one of attraction, at others of repulsion, whilst occasionally no movement whatever was produced.

I will try to reproduce these phenomena in this apparatus (fig. 1). Here are two glass bulbs, each containing a bar of pith about three inches long, and half an inch thick, suspended horizontally by a long fibre of cocoon silk. I bring a hot glass rod, or a candle, towards one of them, and you see that the pith is gradually attracted, following the candle as I move it round the bulb. That seems a very definite fact; but look at the action in the other bulb. I bring the candle, or a hot glass rod, near the other bar of pith, and it is strongly repelled by it, much more strongly than it was attracted in the first instance.

Here, again, is a third fact. I bring a piece of ice near the pith bar which has just been repelled by the hot rod, and it is attracted, and follows the rod round as a magnetic needle follows a piece of iron.

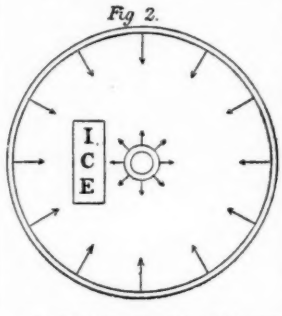
The repulsion by radiation is the key-note of these researches. The movement of a small bar of pith is not very distinct, except to those near, and I wish to make this repulsion evident to all. I have, therefore, arranged a piece of apparatus by which it can be seen by all present. I will, by means of the electric light, project an image of a pendulum suspended *in vacuo* on the screen. You see that the approach of a candle gives the bob a veritable push, and, by alternately obscuring and uncovering the light, I can make the pendulum beat time to my movements.

What, then, is the cause of the contradictory action in these two bulbs—attraction in one, and repulsion in the other? It can be explained in a few words. Attraction takes place when air is present, and repulsion when air is absent.

Neutrality, or no movement, is produced when the vacuum is insufficient. A minute trace of air in the apparatus interferes most materially with the repulsion, and for a long time I was unaware of the powerful action produced by radiation in a "perfect" vacuum.

It is not at first sight obvious how ice or a cold body can produce the opposite effect to heat. The law of exchanges, however, explains this perfectly. The pith bar and the whole of the surrounding bodies are incessantly exchanging heat-rays; and, under ordinary circumstances, the income and expenditure of heat are in equilibrium. Let me draw your attention to the diagram (fig. 2) illustrating what takes place when I bring a piece of ice near the apparatus. The centre circle represents my piece of pith; the arrows show the influx and efflux of heat. A piece of ice brought near cuts off the influx of heat from one side, and, therefore, allows an excess of heat to fall on the pith from the opposite side. Attraction by a cold body is, therefore, seen to be only repulsion by the radiation from the opposite side of the room.

Fig 2.



The later developments of this research have demanded the utmost refinement of apparatus. Everything has to be conducted in glass vessels, and these must be blown together till they make one piece, for none but fused joints are admissible. In an investigation depending for its successful prosecution on manipulative dexterity, I have been fortunate in having the assistance of my friend Mr. Charles Gimingham. All the apparatus you see before you are the fruits of his skilful manipulation, and I now want to draw your attention to what I think is a masterpiece of glass-working—the pump which enables me so readily to produce a vacuum unattainable by ordinary means.

The pump here at work is a modification of the Sprengel pump, but it contains two or three valuable improvements. I cannot attempt to describe the whole of the arrangements, but I will rapidly run over them, as illuminated by the electric light. It has a triple-fall tube, in which the mercury is carried down, thus exhausting with threefold rapidity; it has Dr. M'Leod's beautiful arrangement for measuring the residual gas; it has gauges in all directions, and a small radiometer attached to it to tell the amount of exhaustion that I get in any experiments; it has a contrivance for admitting oil of vitriol into the tubes without interfering with the progress of the exhaustion, and it is provided with a whole series of most ingenious vacuum-taps devised by Mr. Gimingham. The exhaustion produced in this pump is such that a current of electricity from an induction coil will not pass across the vacuum. This pump is now exhausting a torsion-balance, which will be described presently. Another pump, of a similar kind but less complicated, is exhausting an apparatus which has enabled me to pass from the mere exhibition of the phenomena to the obtaining of quantitative measurements.

A certain amount of force is exerted when a ray of light or heat falls on the suspended pith, and I wished to ascertain—

1. What were the actual rays—invisible heat, luminous, or ultra violet—which caused this action?
2. What influence had the colour of the surface on the action?
3. Was the amount of action in direct proportion to the amount of radiation?
4. What was the amount of force exerted by radiation?

I required an apparatus which would be easily moved by the impact of light on it, but which would readily return to zero, so that measurements might be

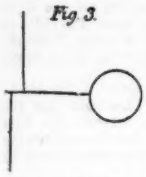


Fig. 3.

obtained of the force exerted when different amounts of light acted on it. At first I made an apparatus on the principle of Zöllner's horizontal pendulum. For a reason that will be explained presently I am unable to show you the apparatus at work, but the principle of it is shown in the diagram (fig. 3). The pendulum represented by this horizontal line has a weight at the end. It is supported on two fibres of glass, one stretched upwards and the other stretched downward, both firmly fastened at the ends, and also attached to the horizontal rod (as shown in the figure) at points near together, but not quite opposite to one another.

It is evident that if there is a certain amount of pull upon each of these fibres, and that the pull can be so adjusted as to counteract the weight at the end and keep it horizontal, the nearer the beam approaches the horizontal line the slower its rate of oscillation. If I relax the tension, by throwing the horizontal beam downwards, I get a more rapid oscillation sideways. If I turn the levelling screw so as to raise the beam and weight, the nearer it approaches the horizontal position the slower the oscillation becomes, and the more delicate is the instrument. Here is the actual apparatus that I tried to work with. The weight at the end is a piece of pith; in the centre is a glass mirror, on which to throw a ray of light, so as to enable me to see the movements by a luminous index. The instrument, enclosed in glass and exhausted of air, was mounted on a stand with levelling screws, and with it I tried the action of a ray of light falling on the pith. I found that I could get any amount of sensitiveness that I liked; but it was not only sensitive to the impact of a ray of light—it was immeasurably more so to a change of horizontality. It was, in fact, too delicate for me to work with. The slightest elevation of one end of the instrument altered the sensitiveness, or the position of the zero point, to such a degree that it was impossible to try any experiments with it in such a place as London. A person stepping from one room to another altered the position of the centre of gravity of the house. If I walked from one side of my own laboratory to the other I tilted the house over sufficiently to upset the equilibrium of the apparatus. Children playing in the street disturbed it. Professor Rood, who has worked with an apparatus of this kind in America, finds that an elevation of its side equal to 1-36,000,000th part of an inch is sufficient to be shown on the instrument. It was therefore out of the question to use an instrument of this construction, so I tried another form (shown in fig. 4), in which a fine glass beam, having discs of pith at each end, is suspended horizontally by a fine glass fibre, the whole being sealed up in glass and perfectly exhausted. To the centre of oscillation a glass mirror is attached.

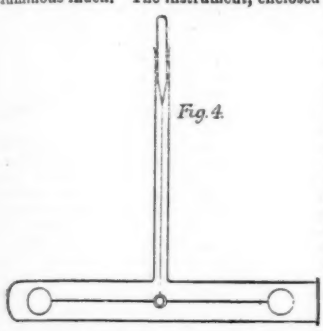


Fig. 4.

Now, a glass fibre has the property of always coming back to zero when it is twisted out of its position. It is almost, if not quite, a perfectly elastic body. I will show this by a simple experiment. This is a long glass fibre hanging vertically, and having a horizontal bar suspended on it. I hold the bar, and turn it half round; it swings backwards and forwards for a few times, but it quickly comes back to its original position. However much twist, however much torsion, may be put on this, it always returns ultimately to the same position. I have twisted glass fibres round, and kept them in a permanent state of twist more than a hundred complete revolutions, and they always came back accurately to zero. The principle of an instrument that I shall describe further on depends entirely on this property of glass.

Instead of using silk to suspend the torsion beam with, I employ a fibre of glass, drawn out very fine before the blow-pipe. A thread of glass of less than the thousandth of an inch in thickness is wonderfully strong, of great stiffness, and of perfect elasticity, so that, however much it is twisted round short of the breaking point, it untwists itself perfectly when liberated. The advantage of using glass fibres for suspending my beam is, therefore, that it always returns accurately to zero after having tried an experiment, whilst I can get any desired amount of sensitiveness by drawing out the glass fibre sufficiently fine.

Here, then, is the torsion apparatus sealed on to a Sprengel pump. You will easily understand the construction by reference to the diagram (fig. 4). It consists of a horizontal beam suspended by a glass fibre, and having discs of pith at each end coated with lamp-black. The whole is enclosed in a glass case, made of tubes blown together, and by means of the pump the air is entirely removed. In the centre of the horizontal beam is a silvered mirror, and a ray from the electric light is reflected from it on to a scale in front, where it is visible as a small circular spot of light. It is evident that an angular movement of the torsion beam will cause the spot of light to move to the right or to the left along the scale. I will first show you the wonderful sensitiveness of the apparatus. I simply place my finger near the pith disc at one end, and the warmth is quite sufficient to drive the spot of light several inches along the scale. It has now returned to zero, and I place a candle near it. The spot of light flies off the scale. I now bring the candle near it alternately from one side to the other, and you see how perfectly it obeys the force of the candle. I think the movement is almost better seen without the screen than with it. The fog, which has been so great a detriment to every one else, is rather in my favour, for it shows the luminous index like a solid bar of light swaying to and fro across the room. The warmth of my finger, or the radiation from a candle, is therefore seen to drive the pith disc away. Here is a lump of ice, and on bringing it near one of the discs the luminous index promptly shows a movement of apparent attraction.

With this apparatus I have tried many experiments, and, amongst others, I endeavoured to answer the question, "Is it light or is it heat that produces the movement?"—for that is a question that is asked me by almost every one: and a good many appear to think that if the motion can be explained by an action of heat, all the novelty and the importance of the discovery vanish. Now, this question of light or heat is one I cannot answer, and I think that when I have explained the reason you will agree with me that it is unanswerable. There is no physical difference between light and heat. Here is a diagram of the visible spectrum (fig. 5). The spectrum, as scientific men understand it, extends from an indefinite distance beyond the red to an indefinite distance beyond the violet. We do not know how far it would extend one way or the other if no absorbing media were present; but, by what we may call a physiological accident, the human eye is sensitive to a portion of the spectrum situated between the line A in the red to about the line H in the violet. But this is not a physical difference between the luminous and non-luminous parts of the spectrum; it is only a physiological difference. Now, the part at the red end of the spectrum possesses, in the greatest degree, the property of causing the sensation of warmth, and of dilating the mercury in a thermometer, and of doing other things which are conveniently classed among the effects of heat; the centre part affects the eye, and is therefore called light; whilst the part at the other end of the spectrum has the greatest energy in producing chemical

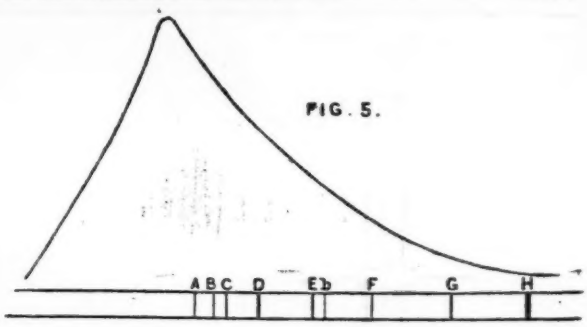


FIG. 5.

action. But it must not be forgotten that any ray of the spectrum, from whatever part it is selected, will produce all these physical actions in more or less degree. A ray here, at the letter C, for instance, in the orange, if concentrated on the bulb of a thermometer, will cause the mercury to dilate, and thus show the presence of heat; if concentrated on my hand, I feel warmth; if I throw it on the face of a thermo-pile, it will produce a current of electricity; if I throw it upon a sensitive photographic plate, it will produce chemical action; and, if I throw it upon the instrument I have just described, it will produce motion. What, then, am I to call that ray? Is it light, heat, electricity, chemical action, or motion? It is neither. All these actions are inseparable attributes of the ray of that particular wave-length, and are not evidences of separate identities. I can no more split that ray up into five or six different rays, each having different properties, than I can split up the element iron, for instance, into other elements—one possessing the specific gravity of iron, another its magnetic properties, a third its chemical properties, a fourth its conducting power for heat, and so on. A ray of light of a definite refrangibility is one and indivisible, just as an element is, and these different properties of the ray are mere functions of that refrangibility, and inseparable from it. Therefore, when I tell you that a ray in the ultra red pushes the instrument with a force of 100, and a ray in the most luminous part has a dynamic value of about half that, it must be understood that the latter action is not due to heat-rays which accompany the luminous rays, but that the action is one purely due to the wave-length and the refrangibility of the ray employed. You now understand why it is that I cannot give a definite answer to the question—"Is it heat or is it light that produces these movements?" There is no physical difference between heat and light, so, to avoid confusion, I call the total bundle of rays which come from a candle or the sun, radiation.

I found, by throwing the pure rays of the spectrum one after the other upon this apparatus, that I could obtain a very definite answer to my first question—"What are the actual rays which cause this action?"

The apparatus was fitted up in a room specially devoted to it, and was protected on all sides, except where the rays of light had to pass, with cotton wool and large bottles of water. A heliostat reflected a beam of sunlight in a constant direction, and it was received on an appropriate arrangement of slit, lenses, prisms, &c., for projecting a pure spectrum. Results were obtained in the months of July, August, and September; and they are given in the figure (fig. 5) graphically as a curve, the maximum being in the ultra-red and the minimum in the ultra-violet. Taking the maximum at 100, the following are the mechanical values of the different colours of the spectrum:—

Ultra-red	100
Extreme red	85
Red	73
Orange	66
Yellow	57
Green	41
Blue	22
Indigo	8½
Violet	6
Ultra-violet	5

A comparison of these figures is a sufficient proof that the mechanical action of radiation is as much a function of the luminous rays as it is of the dark heat-rays.

The second question—namely, "What influence has the colour of the surface on the action?" has also been solved by this apparatus.

In order to obtain comparative results between discs of pith coated with lamp-black and with other substances, another torsion apparatus was constructed, in which six discs *in vacuo* could be exposed one after the other to a standard light. One disc always being lamp-blacked pith, the other discs could be changed so as to get comparisons of action. Calling the action of radiation from a candle on the lamp-blacked disc 100, the following are the proportions obtained:—

Lamp-blacked pith	100
Iodide of palladium	87·3
Precipitated silver	56
Amorphous phosphorus	40
Sulphate of baryta	37
Milk of sulphur	31
Red oxide of iron	28
Scarlet iodide of mercury and copper	22
Lamp-blacked silver	18
White pith	18
Carbonate of lead	13
Rock-salt	6·5
Glass	6·5

This table gives important information on many points—one more especially: the action of radiation on lamp-blacked pith is 5½ times what it is on plain pith. A bar like those used in my first experiment, having one half black and one half white, exposed to a broad beam of radiation, will be pushed with 5½ times more strength on the black than on the white half, and, if freely suspended, will set at an angle greater or less, according to the intensity of the radiation falling on it.

This suggests the employment of such a bar as a photometer, and I have accordingly made an instrument on this principle. Its construction is shown in the diagram (fig. 6). It consists of a flat bar of pith, A, half black and half white, suspended horizontally in a bulb by means of a long silk fibre. A reflecting mirror, B, and small magnet, C, are fastened to the pith, and a controlling magnet, D, is fastened outside, so that it can slide up and down the tube, and thus increase or diminish sensitiveness. The whole is completely exhausted and then enclosed in a box lined with black velvet, with apertures for the rays of light to pass in and out. A ray of light from a lamp, F, reflected from the mirror, B, to a graduated scale, G, shows the movements of the pith bar.

The instrument fitted up for a photometric experiment is in front of me on the table. A beam from the electric light falls on the little mirror, and is thence reflected back to the screen, where it forms a spot of light, the dis-

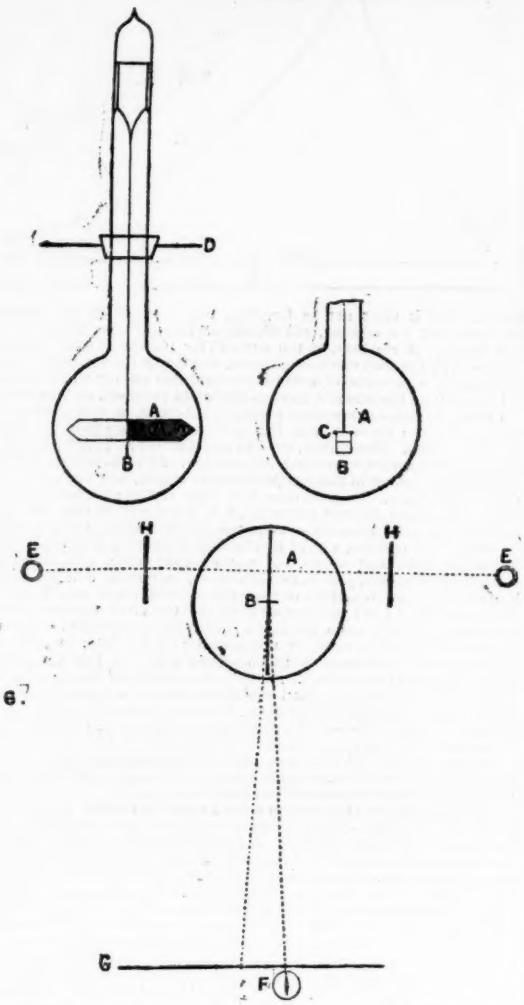


FIG. 6.

placement of which to the right or the left shows the movement of the pith bar. One end of the bar is blacked on each side, the other end being left plain. I have two candles, E E, each 12 inches off the pith bar, one on each side of it. When I remove the screens, H H, the candle on one side will give the pith a push in one direction, and the candle on the other side will give the pith a push in the opposite direction, and as they are the same distance off they will neutralize each other, and the spot of light will not move. I now take the two screens away: each candle is pushing the pith equally in opposite directions, and the luminous index remains at zero. When, however, I cut one candle off, the candle on the opposite side exerts its full influence, and the index flies to one end of the scale. I cut the other one off and obscure the first, and the spot of light flies to the other side. I obscure them both, and the index comes quickly to zero. I remove the screens simultaneously, and the index does not move.

I will retain one candle 12 inches off, and put two candles on the other side 17 inches off. On removing the screens you see the index does not move from zero. Now the square of 12 is 144, and the square of 17 is 289. Twice 144 is 288. The light of these candles, therefore, is as 288 to 289. They therefore balance each other as nearly as possible. Similarly I can balance a gaslight against a candle. I have a small gas-burner here, which I place 28 inches off on one side, and you see it balances the candle 12 inches off. These experiments show how conveniently and accurately this instrument can be used as a photometer. By balancing a standard candle on one side against any source of light on the other, the value of the latter in terms of a candle is readily shown; thus in the last experiment the standard candle 12 inches off is balanced by a gas-flame 28 inches off. The lights are, therefore, in the proportion of 12_2 to 28_2, or as 1 to 5·4. The gas-burner is, therefore, equal to about $5\frac{1}{2}$ candles.

In practical work on photometry it is often required to ascertain the value of gas. Gas is spoken of commercially as of so many candle power. There is a certain "standard" candle which is supposed to be made invariable by Act of Parliament. I have worked a great deal with these standard candles, and I find them to be among the most variable things in the world. They never burn with the same luminosity from one hour to the other, and no two candles are alike. I can now, however, easily get over this difficulty. I place a "standard" candle at such a distance from the apparatus, that it gives a deflection of 100 degrees on the scale. If it is poorer than the standard, I bring it nearer; if better, I put it farther off. Indeed, any candle may be taken; and if it be placed at such a distance from the apparatus that it will give a uniform deflection—say, of 100 divisions—the standard can be reproduced at any subsequent time; and the burning of the candle may be tested during the photometric experiments by taking the deflection it causes from time to time, and altering its distance, if needed, to keep the deflection at 100 divisions. The gaslight to be tested is placed at such a distance on the opposite side of the pith bar that it exactly balances the candle. Then, by squaring the distances, I get the exact proportion between the gas and the candle.

Before this instrument can be used as a photometer or light-measurer, means must be taken to cut off from it all those rays coming from the candle or gas which are not actually luminous. A reference to the spectrum diagram (fig. 5) will show that at each end of the coloured rays there is a large space inactive, as far as the eye is concerned, but active in respect to the production of motion; strongly so at the red end, less strong at the violet end. Before the instrument can be used to measure luminosity, these rays must be cut off. We buy gas for the light that it gives, not for the heat it evolves on burning, and it would, therefore, never do to measure the heat and pay for it as light.

It has been found that a clear plate of alum, whilst letting all the light through, is almost, if not quite, opaque to the heating rays below the red. A solution of alum in water is almost as effective as a crystal of alum; if, therefore, I place in front of the instrument glass cells containing an aqueous solution of alum, the dark heat-rays are filtered off.

But the ultra-violet rays still pass through, and to cut these off I dissolve in the alum solution a quantity of sulphate of quinine. This body has the property of cutting off the ultra-violet rays from a point between the lines G and H. A combination of alum and sulphate of quinine, therefore, limits the action to those rays which affect the human eye, and the instrument, such as you see it before you, becomes a true photometer.

This instrument, when its sensitiveness is not deadened by the powerful control magnet I am obliged to keep near it for these experiments, is wonderfully sensible to light. In my own laboratory a candle 86 feet off produces a decided movement, and the motion of the index increases inversely with the square of the distance, thus answering the third question—"Is the amount of action in direct proportion to the amount of radiation?"

The experimental observations, and the numbers which are required by the theoretical diminution of light with the square of the distance, are sufficiently close, as the following figures show:—

				Degrees.
Candle	6 feet off	gives a deflection of	. . . . .	218·0
"	12	"	"	54·0
"	18	"	"	24·5
"	24	"	"	13·0
"	10	"	"	77·0
"	20	"	"	19·0
"	30	"	"	8·5

The effect of two candles, side by side, is practically double, and of three candles three times that of one candle.

In the instrument just described, the candle acts on a pith bar, one end of which is blacked on each side. But suppose I black the bar on alternate halves, and place a light near it sufficiently strong to drive the bar half round. The light will now have presented to it another black surface in the same position as the first, and the bar will be again driven in the same direction half round. This action will be again repeated, the differential action of the light on the black and white surfaces keeps the bar moving, and the result will be rotation.

Here is such a pith bar, blacked on alternate sides, and suspended in an exhausted glass bulb (fig. 7). I project its image on the screen, and the strong light which shines on it sets it rotating with considerable velocity. Now it is slackening speed, and now it has stopped altogether. The bar is supported on a fibre of silk, which has twisted round till the rotation is stopped by the accumulated torsion. I put a water-screen between the bar and the electric light to cut off some of the active rays, and the silk untwists, turning the bar in the opposite direction. I now remove the water, and the bar revolves rapidly as at first.

FIG. 7.

From suspending the pith on a silk fibre to balancing it on a point the transition is slight; the interfering action of torsion is thereby removed, and the instrument rotates continuously under the influence of radiation. Many of these little pieces of apparatus, to which I have given the name of radiometers, are on the table, revolving with more or less speed. Their construction is very simple. They are formed of four arms of very fine glass, supported in the centre by a needle-point, and having at the extremities thin discs of pith, lamp-blacked on one side, the black surfaces all facing the same way. The needle stands in a glass cup, and the arms and discs are delicately balanced, so as to revolve with the slightest impetus.

Here are some rotating by the light of a candle. This one is now rather an historical instrument, being the first one in which I saw rotation. It goes very slowly in comparison with the others, but it is not bad for the first instrument of the sort that was ever made.

The speed with which a sensible radiometer will revolve in the sun is almost incredible; and the electric light, such as I have in this lantern, cannot be far short of full sunshine. Here is the most sensitive instrument I have yet made, and I project its image on the screen, letting the full blaze of the electric light shine upon it. Nothing is seen but an undefined nebulous ring, which becomes at times almost invisible. The number of revolutions per second cannot be counted, but they must be several hundreds, for one candle has made it spin round 40 times per second.

I have called the instrument the radiometer, because it will enable me to measure the intensity of radiation falling on it by counting the revolutions in a given time; the law being, that the rapidity of revolution is inversely as the square of the distance between the light and the instrument.

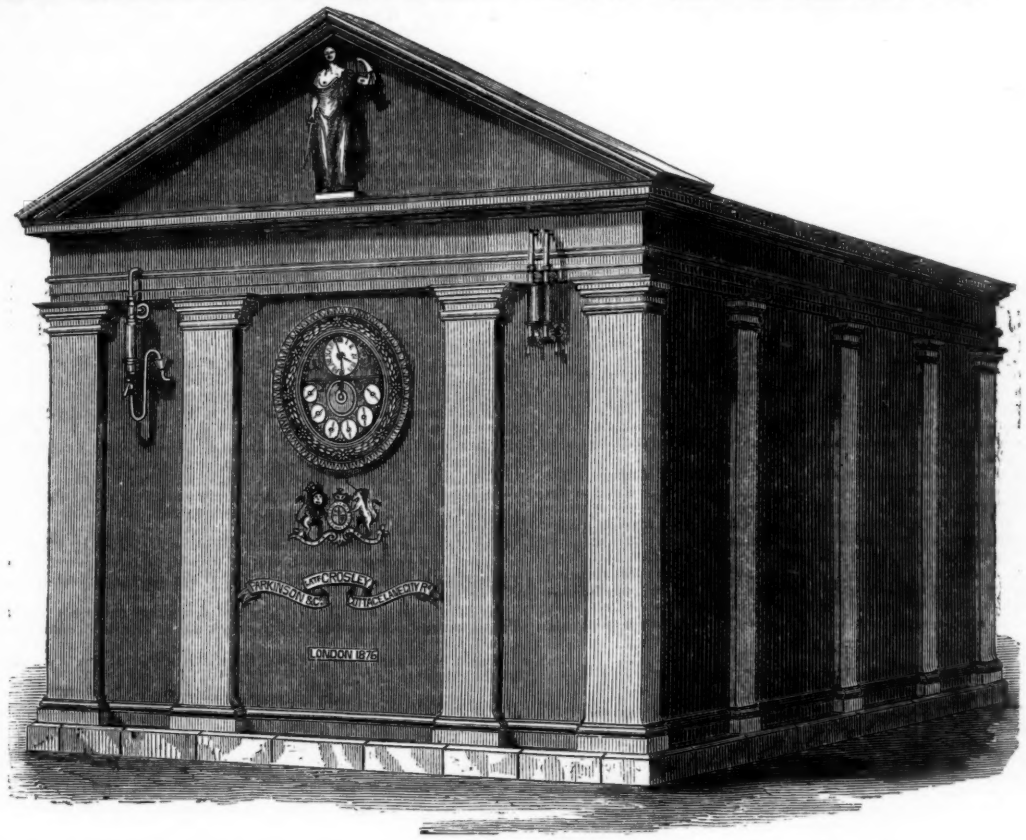
When exposed to different numbers of candles at the same distance off, the speed of revolution in a given time is in proportion to the number of candles—two candles giving twice the rapidity of one candle, and three, three times, &c.

The position of the light in the horizontal plane of the instrument is of no consequence, provided the distance is not altered; thus two candles, one foot off, give the same number of revolutions per second, whether they are side by side or opposite to each other. From this it follows that if the radiometer is brought into a uniformly lighted space, it will continue to revolve.

FATAL ACCIDENT AT THE HUDDERSFIELD CORPORATION GAS-WORKS.—On Thursday morning last a fatal accident occurred at the gas-works in Leeds Road, Huddersfield. It appears that a new gasholder is being constructed at the works, and for that purpose Robert Evans, a foreman pipe-layer, and Thomas Dolan, a labourer, both in the employ of the corporation, were at the bottom of a dry well, 30 feet deep, connected with the gasholder-tank, laying the foundation for a syphon-box weighing about 2 tons. This syphon-box was below them, and was suspended down the well by a rope, which was attached to the centre of a baulk of timber at the top of the well. The baulk was laid on the top of two temporary upright pillars—one on each side of the well—4 feet square at the base, and decreasing in size towards the top. The pillars were constructed of loose stones and bricks, and about a quarter to twelve a large number of these bricks, it is supposed through becoming shifted by the syphon-box suspended in the well being lifted up and down for the purpose of adjustment in its position, fell down the well, and the baulk of timber slipped off. George Bentley, a labourer, who was holding the rope at the top of the well, fell down the well, but kept his hold of the rope. He was only slightly injured about the hands, and was able to get up a ladder to the top of the well, but the other men were brought up in baskets. Dolan, whose head had sustained serious injury, was quite unconscious. Both he and Evans were taken to the Infirmary. Evans was severely cut about the head and face, and bruised about the body, but Dolan, who had a dreadful depressed fracture of the skull, remained unconscious until about eight o'clock the same night, and then died from the effects of his injuries.

LARGE STATION-METER AT THE BROMLEY GAS-WORKS.

The station-meter represented in the annexed engraving is the largest instrument for measuring gas that has ever been constructed. It has just been completed by Messrs. Parkinson and Co., of Cottage Lane, City Road, for the new works of the Imperial Gas Company at Bromley. The tank of this meter is 18 feet by 22, with mouldings projecting 9 inches further. All the joints are planed, and the plates strengthened with deep ribs and flanges to withstand the weight of water, about 120 tons. The measuring drum is 15 feet 6 inches diameter, and passes 2200 cubic feet per revolution. The meter, therefore, at the usual speed of 100 revolutions per hour, would in that time pass 220,000 feet. The tin work of drum is supported by five sets of bosses, arms, and hoops. The drum altogether, with shaft and ironwork, weighs about six tons. The connexions are 36 inch, and the index registers up to 100 millions.



IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There has again been next to no business transacted in this district during the week, so far as the iron trade is in question. The greatest establishments in the locality—viz., the Atlas Works of John Brown and Co., Limited, and the Cyclops Works of Charles Cammell and Co., Limited—have been closed all the week, and still remain so, it being highly improbable that a resumption of operations will be brought about until the workmen are willing to assent to the reductions, of which notice has been served upon them. Another reason why the ironmasters are unwilling to begin work again is that the supply of fuel is now exceedingly limited, the collieries belonging to the above companies being both idle owing to the miners strike. At the large Thornoliffe Iron-Works of Messrs. Newton, Chambers, and Co., the two blast furnaces were damped down on Saturday last, and a large number of men were in consequence discharged. At Clay Cross, Staveley, Sheepbridge, and other works, a similar state of things is current, whilst at other establishments the men have been served with notices, under which their services can be dispensed with as occasion may require.

The miners strike itself has now lasted nearly three weeks, and there are but the slightest tokens of its coming to a termination. The men have held several mass meetings at Staveley, Barnsley, and elsewhere, and have, with remarkable accord, resolved not to concede the reduction of 15 per cent. of which the employers gave notice prior to the strike. They appear to be willing to concede 7½ per cent., or, at the outside, 10 per cent., but they are evidently determined not to give way any further than that limit.

It appears that there are 18,000 men out at the collieries owned by the Associated Coalowners, and 13,000 at the pits which do not belong to the colliery proprietors who are members of the Association. At two collieries the men are working at a drop of 10 per cent.; at five or six at a reduction of 7½ per cent., whilst at about 25 (mostly small concerns) they are working on the understanding that they will fall in with the general result of the strike.

It is expected that coal will be advanced in price in a few days unless the dispute be brought to an end, of which there appears to be but the slightest probability. Steam coal is not in great request, except a few contract lots for export to German and Baltic ports. Gas coal is, for the most part, quiet, and up to the time of writing I do not hear of any particular difficulty as to supply having arisen.

There is no change whatever to record in the price of iron in the district.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The usual weekly meeting of the iron trade of this district was this week more spirited and favourable than has been the case for some time past, and the announcement of a reduction of £1 per ton on branded iron was received with much satisfaction. The rate for marked bars is now £9 per ton, the other descriptions of merchant iron being in the usual proportion to that standard. Unmarked iron is now quoted on the basis of £7 10s. per ton for bars, but prices are still irregular, although these reductions have not yet had any marked influence on the demand. Yet stocks in the hands of merchants and consumers are reported to be very low, and it is known that there are some good specifications for iron of South Staffordshire brands, on account of the Indian and Australian markets, now awaiting distribution; and though the trade must still be pronounced very dull and depressed, yet the prospects of business are more encouraging than lately reported. The reduction of 7½ per cent. in ironworkers wages, according to the award of the Mayor of Birmingham, will date from the 22nd inst. Some little misunderstanding has arisen on the question amongst a section of the operatives in the West Bromwich district, but it is believed that the difficulty is now practically settled.

In pig iron the market still rules dull, and further restrictions in the output are reported; but rather more activity is now noticeable at the ironfoundry and engineering establishments of the district, and hopes are entertained of a more buoyant demand for foundry pigs shortly.

There has been a rather more spirited inquiry for coal since the reduction announced a few days ago, and upon which the reduction in iron is based. The reduction amounts to 2s. per ton on best furnace coal, and will date from the 1st of May. The prices for coal, west of Dudley, will now be—for best thick coal 16s., furnace coal 11s., lumps 10s., slack 4s. 6d. per ton, delivered into boats or trucks at the collieries. The colliers wages will, at the same time, be reduced to the extent of 6d. and 3d. per day for thick coal and thin coal colliers respectively, so that the wages of the former will be 3s. 6d., and the latter 2s. 6d. per day of eight hours; but the masters are anxious to have the working hours extended, in which case wages will be proportionately increased.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is still a good deal of pushing to effect sales of round coal, and the supplies in the market are so plentiful, that buyers are able to secure small concessions without much difficulty, and the list rates continue purely nominal. In fact, it may be said that there are no list rates at present, so far as sales in bulk are concerned. Pit prices in the Wigan district, so far as they are ascertainable, are about as under:—Arley Mine coal 10s. to 11s. 6d. and 12s. per ton, Pemberton four-feet 9s. 6d. to 10s. 6d., and common coal 7s. 6d. to 8s. per ton. Engine classes of fuel meet with a tolerably fair demand, and good burgy is not difficult to sell at prices ranging from 6s. to 6s. 6d. per ton at the pit. Slack also being rather scarce generally, although there are several considerable stocks still in the Manchester district, commands full prices, and 4s. 6d. to 5s. per ton is obtained for the better sorts at the pit mouth. Gas coal does not yet stir to any extent.

Business in the shipping trade is still confined to very limited proportions. There are very few shipments of best coal, what is being bought being chiefly inferior classes of fuel, which can be obtained at extremely low prices, these ranging in some cases as low as 7s. 6d. per ton on delivery at the high level, Liverpool.

Coke continues in the same inanimate condition that has been previously reported, and prices are very irregular.

The great proportion of the pits throughout Lancashire are still working short time—seven days a fortnight being about the average, and notwithstanding this, stocks are accumulating to a small extent.

One or two districts continue to be agitated with wages questions. Although the men in the Bolton district are gradually returning to work, the notices for a reduction in the Atherton district have resulted in about 1300 colliers turning out. In the Tyldesley district the men are working on the renewed notices for a reduction, and the probability of a reduction in the Wigan district is being talked about.

The iron market here continues very dull, and there is scarcely any demand for either the raw or manufactured material. Lancashire pig iron is a little

easier, 60s. for No. 3 foundry, and 59s. for No. 4 forge being now quoted for delivery in Manchester, and there is no doubt makers would be open to lower offers if business could be done. Manufactured iron is very flat, and prices, which are purely nominal, may be given as under:—Ordinary Middlesbrough bars, £7 5s. to £7 7s. 6d.; Lancashire, £7 7s. 6d. to £7 10s.; Sheffield and Staffordshire, £7 10s. to £7 12s. 6d., delivered into the Manchester district.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of the North of England maintains the improved firmness which was established in April. There can be no doubt that this improvement is owing to the strike of miners in South Yorkshire. A considerable quantity of coals is shipped from the South Yorkshire pits at Hull and Grimsby; but, in consequence of the strike, foreign vessels which would have gone to load at those places, have come to the Tyne to take in coals, and there has been a very considerably improved demand for steam coals of all sorts, shipping turns being much longer. Households have also been in request, and there has been a pretty steady demand for gas coals, especially for the Baltic, at from 7s. 6d. to 9s. per ton. Manufacturing coals, which have been a drug in the market so long, have also partaken of the improvement. As might have been expected, the pits are working better time.

Shipping freights are pretty steady. Steamers are kept very well employed in the coasting trade, at from 4s. 9d. to 5s. per ton; sailing vessels at from 5s. 6d. to 5s. 9d. per ton. The French ports, £8 to £8 5s. for small sailing ships; Exeter, £8 to £8 10s.; Plymouth and Falmouth, £7 10s.; Jersey, £7 10s. per keel; Poole, 7s. per ton; the East Coast, 6s. per ton. A good few coals have been sent out to the Russian ports in the Baltic, and freights thence have improved. Trade, however, to the Mediterranean, through the competition with South Wales, is weaker, and freights are down £1 per keel.

The general tone of the iron market in the Cleveland district was slack last week, and prices were lower. Foundry iron, however, has been in better demand than forge sorts. A good few gas and water pipes are likely to be shipped abroad and to the South of England from Birtley, Gateshead, and Newcastle during the season, and that branch of business, with some other manufacturing iron trades on the Tyne, is doing tolerably well.

The chemical trade keeps remarkably dull. There is little demand for America, and not much doing for the continent of Europe. The men, as reported last week, have put in a demand of 20 per cent. upon the present rate of wages. The men seem pretty firm, and it is quite likely that a crisis will be precipitated in consequence. It seems rather a strange thing to put in so large a demand of advance with a falling market, but, of course, the men know best their own affairs. At the same time, as reported last week, the masters threaten to close their factories if the men drive them to the wall. The chemical manufacturers allege that they are receiving less money for their goods than they did last year at this time, and that the prospects of the season are very unsatisfactory.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

I will not run the risk of anticipating your official report of the proceedings of the fourth annual meeting of the West of Scotland Association of Gas Managers, which was held in Greenock last Thursday; but I may be allowed a few words in this week's budget of notes in reference to the matter. Of course as the president (Mr. William Dunlop, Hamilton Corporation Gas-Works) has been embroiled in a stiff discussion on gas-exhausters in the pages of the JOURNAL OF GAS LIGHTING within the last few months, he was in a measure bound to take advantage of the earliest opportunity to reply to those correspondents who had challenged his opinions and conclusions; and this he did with a considerable amount of vigour. In electing Mr. Levi Monk, of Lanark, to be Mr. Dunlop's successor as the president of the association, the members acted wisely. That gentleman is one of the very few Englishmen who hold gas managerships in Scotland, but at the same time he is highly respected by those of his Scotch colleagues who know him. A short paper by Mr. Smith, of Newton-on-Ayr, described a very simple but ingenious apparatus for lighting and extinguishing public lamps by variations of pressure; and another one by Mr. Martin, Kilmalcolm, described his method of getting quit of carbon in the retorts and choked ascension-pipes. Mr. Young, of Clippens, followed up with another instalment of the subject, on which he has worked so hard and to such good purpose during the last few years, and on which he read his first paper a year ago at the Lanark meeting. I refer to the subject of "Diffusion of Hydrocarbon Vapours in Coal Gas." There was not time to read the paper *in extenso*, nor yet to discuss it, but doubtless after it has appeared in the JOURNAL its great value will be seen by those gentlemen who pay any special attention to the chemical principles involved in making gas, and in the permanent improvement of the inferior qualities of gas. Glasgow was fixed upon as the place for holding the autumn meeting of the association, and after Mr. Key, of Tradeston Corporation Gas-Works, Glasgow, had described and practically illustrated the operation of his safety station-governor, we left to visit the Greenock Gas-Works, at the invitation and under the guidance of Mr. Samuel Stewart, C.E., the genial and courteous manager. There was a very large party, numbering 60 or 70, and everybody was highly delighted with the inspection. The works as a whole and the arrangements of the various parts were very much admired, and Mr. Stewart was cordially thanked for the hospitable and pleasant manner in which he received his visitors. A very enjoyable dinner was afterwards served at the "White Hart" Hotel to about 50 guests, Mr. Dunlop occupying the chair, and Mr. Monk the vice-chair. The whole day's proceedings were very successful.

A special general meeting of the shareholders of the Kinross and Milnathort Gaslight Company was recently held, for the purpose of considering the expediency of erecting a new gasholder, securing additional accommodation, and authorizing the directors to borrow money for carrying out the proposed improvements. After some discussion the proposals were agreed to.

The last report for Glasgow gas states the average illuminating power at from 27·30 standard candles at Dalmarnock station, to 29·52 at Tradeston station. The maximum was up at 30·62 candles at Tradeston station, and in no case was the minimum found to be under 25 candles at any of the stations.

As a copy of the report of the select committee on Sir Windham Anstruther's Gas Supply Bill may not yet have reached you, I may mention one or two facts that have reached Glasgow. The committee appear to have divided four times while going through the clauses of the bill. On the first occasion Sir Edward Colebrook had ten members of the committee against him; and on the last occasion Mr. Whitelaw was in the same predicament, being the sole representative of the minority, with nine members against him. The last division was the one in which the Glasgow Gas Corporation was more immediately concerned. Sir E. Colebrooke proposed to leave out sub-section A from the first clause, and the only member of the committee who opposed this was Mr. Whitelaw, the following constituting the majority in the division:—Mr. Salt, Sir E. Colebrooke, Mr. Campbell-Bannerman, Mr. Cawley, Mr. Grieve, Mr. O'Shaughnessey, Sir Windham Anstruther, Sir W. Cuninghame, and Mr. Dundas.

At a meeting of the directors of the Newport Gaslight Company, held on Saturday, the 22nd of April, Mr. Adamson, of the Airdrie Iron Company, who has had much experience in the making of gasholders, attended by request, and gave the directors his views with regard to the extension of the Newport Gas-Works. Like Mr. M'Crae, of Dundee, he is averse to the telescoping of the present gasholders, on the ground that they are much too small for the operation to be beneficial. He also recommends that the smaller of the two gasholders, which is 20 years old, should be taken out, and one considerably larger substituted for it. He made other suggestions by which the limited space of the present works could be turned to better account, and it was resolved to obtain plans and estimates for the new gasholder, as suggested by Mr. Adamson.

Nothing of importance falls to be stated in reference to the pig iron market. Prices have been below 58s., but the week closes with business done at 58s. 1½d. cash.

The coal market is still duller than it was, and in some districts trade is almost at a standstill.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

1568.—ALLEN, T., Southsea, Hants, "Improvements in cisterns." April 13, 1876.

1610.—COLLET, H., and DENANS, J. B., Paris, "Improvements in apparatus for regulating the flow of liquids." April 17, 1876.

1615.—MORRIS, W., Deptford, London, "Improvements in apparatus or means for establishing a communication with pipes or vessels containing fluid under pressure." April 18, 1876.

1618.—MACNEILL, J., South Kensington, London, "Improvements in apparatus for measuring and registering the flow and supply of water to consumers, or for other purposes." April 18, 1876.

1631.—LAIDLAW, D., Glasgow, "Improvements in lighting railway carriages, and in the mechanism or apparatus employed therefor, the same being applicable for lighting tramway cars, ships, factories, and other buildings." April 19, 1876.

1649.—CLARK, A. M., Chancery Lane, London, "Improvements in gas-retorts, and apparatus used therewith." A communication. April 20, 1876.

1678.—HART, J. L., London, "An improvement in gas-meters." A communication. April 21, 1876.

1682.—LANGSTON-JONES, H., Holborn, London, "Improvements in solid and liquid disinfectants and deodorizers." April 21, 1876.

Share List of Metropolitan Gas and Water Companies.

(*Corrected by Mr.* F. N. GOLDING, *Sun Court, Cornhill, from the latest Stock Exchange Quotations.*)

Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.	Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.	Number of Shares issued.	Amount per Share	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.
	£	GAS COMPANIES.	£ s. d	£ s. d	£		£	GAS COMPANIES.	£ s. d	£ s. d	£		£	GAS COMPANIES.	£ s. d	£ s. d	£
8000	20	Anglo-Romano . .	20 0 0	10 0 0	14—16	1560000	100	*Imperial*	100 0 0	10 0 0	200—203	15000	10	*Surrey Consumers*	10 0 0	10 0 0	20—20½
5000	20	Bahia (Limited). .	20 0 0	..	10—11	78000	12½	Do., new shares .	12 10 0	7 0 0	18½—18¾	10000	10	Do., new	8 0 0	10 0 0	8—8½pm
1008	20	Do., preference .	20 0 0	..	23—25	1300	100	Do., bonds . . .	£100	10 0 0	210—220	9000	4	Unit. Genl.,Limrck.	4 0 0	2 10 0	2—2½
1000	20	Do., do., redeem.	20 0 0	..	20—22	56000	50	*Impvl. Continental*	43 15 0	9 5 6	76—78	1500	10	*Wandsw. & Putney*	10 0 0	10 0 0	14—15
1500	20	Do., perpet. pref.	20 0 0	7 10 0	19—21	3000	40	*Independent* . . .	40 0 0	10 0 0	86—88	1500	10	Do.	10 0 0	7 10 0	11—12
40000	5	Bombay (Limited).	5 0 0	7 0 0	7¼—7⅜	3060	10	Do.	10 0 0	5 0 0	9½—10½	2957	10	Do.	10 0 0	7 0 0	
10000	5	Do., fourth issue.	4 0 0	7 0 0	1½-⅝pm.	3000	20	Do.	20 0 0	7 10 0	31—33	993	10	Do.	3 0 0	7 0 0	
10000	20	British (Limited) .	20 0 0	10 0 0	38—40	4500	10	Do., D	10 0 0	..	21—23	16000	5	*West Ham*	5 0 0	10 0 0	7⅞—8
7500	20	Cagliari (Limited).	20 0 0	5 0 0	16—18	3783501.	Stk.	*London*	100 0 0	10 0 0	198—202	10000	5	Do., new shares .	2 10 0	10 0 0	3—4
50000l.	Stk.	*Commercial* . . .	100 0 0	10 0 0	199—202	150000l.	Stk.	Do., 1st pref. . .	100 0 0	6 0 0	125—130						
20000	20	Continental Union.	20 8 0	8 0 0	21—22	14450	Stk.	Do., 2nd pref. . .	100 0 0	6 0 0							
20000	20	Do., new	12 10 0	8 0 0	½-1¼ pm.	4350	Stk.	Do., 3rd pref. . .	100 0 0	6 0 0							
10000	20	Do., preference .	20 0 0	7 0 0	26—28	7622	25	Do., A shares . .	12 10 0	6 0 0							
5000	10	*Crystal Palace Dis.*	10 0 0	10 0 0	20—20¼	26805l.	All	Do., Debent. stk.	100 0 0	5l. & 6l.				WATER COMPANIES.			
5000	10	Do., preference .	10 0 0	6 0 0	12—13	15000	5	Malta & Med.(Lim.)	5 0 0	2 0 0	2½—3	12000	100	Chelsea	100 0 0	6 0 0	140—142
10000	7	Do., ordinary . .	10 0 0	7 0 0	13¼—14¾	6000	5	Do., preference .	5 0 0	7 10 0	4¾—5¼	1800000	100	East London . . .	100 0 0	6 0 0	145—147
2500	10	Do., converted .	2 0 0	10 0 0	1¼-2 pm.	20000	5	Mauritius (Limited)	2 0 0	..	1¼—1⅝	8000	50	Grand Junction . .	50 0 0	7 0 0	79—81
2500	7	Do., converted .	2 0 0	7 0 0	1-1½ pm.	25000	20	Monte Video (Lim.)	20 0 0	8 0 0	18—19	5840	25	Do., ½ shares . .	25 0 0	7 0 0	39½—40½
23406	10	European (Limited)	10 0 0	10 0 0	16¼—17⅛	8000	10	Nictheroy, Brzl. (L.)	10 0 0	..		2160	25	Do., new ditto; max. div., 7½ p.c.	25 0 0	7 0 0	34½—35½
12000	10	Do., new shares.	7 10 0	10 0 0	4½—5	30000	5	Oriental (Calcutta).	5 0 0	9 10 0	8¼—8¾						
35406	10	Do., new shares .	5 0 0	10 0 0	3⅝—4¼	30000	5	Do., new shares .	3 0 0	9 10 0	2—2½pm.	4396	100	Kent	100 0 0	7 0 0	165—166
222656	10	*Gaslight & Coke* A.	10 0 0	10 0 0	20—20⅛	10000	5	Ottoman (Limited).	5 0 0	3 0 0	2½—3	5339	100	Lambeth	100 0 0	6 5 0	143—146
10000	10	Do. B.	10 6 0	4 0 0	8—8⅛	17500	10	Pará (Limited) . .	10 0 0	7 0 0	3½—4¼	1161	100	Do.	45 0 0	6 5 0	130-35pm
703	10	Do. 5 per ct. pref. conv., 1st issue.	10 0 0	5 0 0	18¼—18⅞	27000	20	*Phœnix*	20 0 0	10 0 0	39—41	442	100	New River	100 0 0	8 0 0	170—180
						360000l.	100	Do., new	55 0 0	7 10 0	90—93	4475	100	Do.	30 0 0	8 0 0	50—55
627	10	Do. do., 2nd do. .	10 0 0	5 0 0	18¼—18⅞	144000l.	Stk.	Do., capitalized .	100 0 0	5 0 0	100—103	400000	100	Do., deb. stk., 4 p.c.	100 0 0	4 0 0	97—99
30000	10	Do. do., 3rd do. .	10 0 0	5 0 0	19—19⅛	36000	20	Rio de Janeiro (L.)	20 0 0	10 0 0	31—33	3036	100	Southwrk. & Vauxh.	100 0 0	5 5 0	112—114
50000	10	Do. do., 4th do. .	4 0 0	5 0 0	6—6¼	7359	5	Singapore (Limited)	5 0 0	7 10 0	5¼—5⅝	1296	100	Do., pref. stock .	100 0 0	5 5 0	108—110
50000	10	Do. 5th do. .	2 0 0	..	4¼-4⅜pm	2000	5	Do., preference .	5 0 0	7 10 0	5⅜—6¼		100	Do., D shares . . .	100 0 0	5 5 0	111—113
20000	10	Do. C 10 p.c. pref.	10 0 0	10 0 0	23¼—24¼	1500	32½	Shanghai	32 10 0	12 0 0	30—32			Do.	..	4 10 0	
12000	25	Do. D do. do. .	25 0 0	10 0 0	56—58	4000	50	*South Metropolitan*	50 0 0	10 0 0	101—103		100	Do., new ord.	..	4 10 0	
6300	5	Georgetown, Guiana	5 0 0	5 0 0		4000	12½	Do.	12 10 0	10 0 0	24½—25¼	1600	100	Do., new ord. No. 1	40 0 0	4 10 0	112—114
5600	10	Hong Kong (Lim.)	10 8 0	12 0 0	15—16	20000	12½	Do., new shares .	5 0 0	10 0 0	10—10⅛ pm.	12172	61	West Middlesex . .	61 0 0	6l. p.sh.	133—138

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

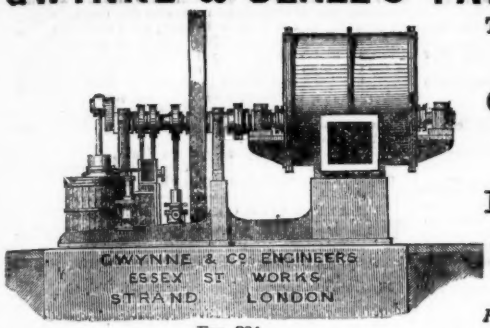


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.

HAVE MADE THE LARGEST AND MOST PERFECT

EXHAUSTING MACHINERY

Ever produced, and the most economical in working.

Prices and every information on application.

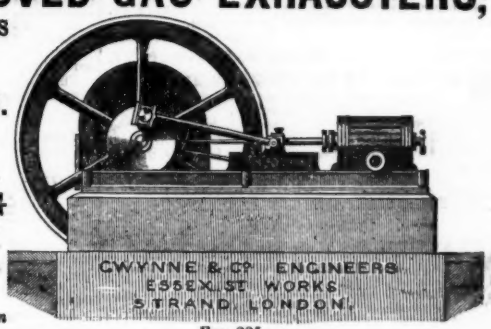


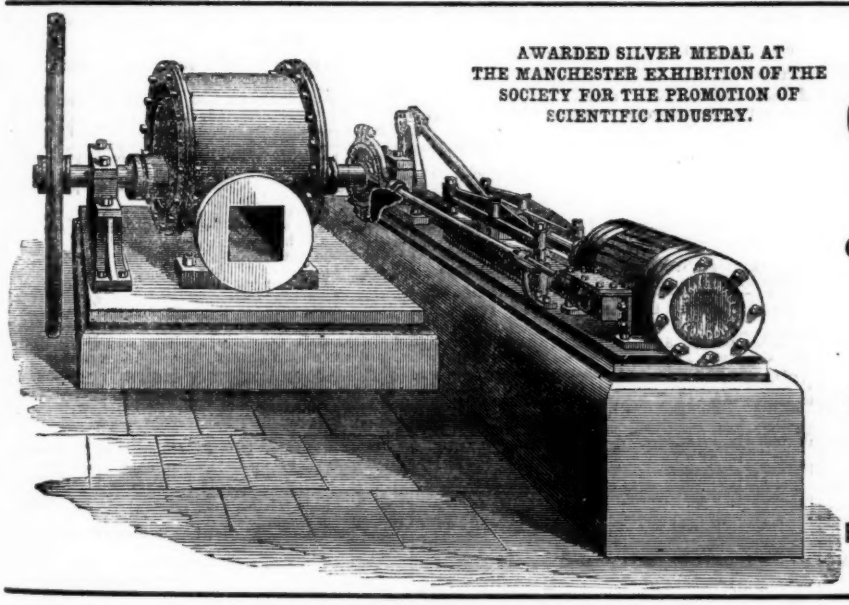
FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the most perfect system of action yet discovered. Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the excellence of the article produced, and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES, CAN BE HAD ON APPLICATION TO

GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.

G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.



AWARDED SILVER MEDAL AT THE MANCHESTER EXHIBITION OF THE SOCIETY FOR THE PROMOTION OF SCIENTIFIC INDUSTRY.

BEALE'S

Improved Patent

GAS-EXHAUSTERS

WITH

ENGINES COMBINED.

Sole Makers,

GEORGE WALLER & CO.

Makers of

ENGINES, EXHAUSTERS,
INDEX and DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, and other PUMPS,
SCRUBBERS and PURIFIERS,
CONDENSERS, BOILERS, &c.

PHŒNIX ENGINEERING WORKS,

HOLLAND STREET, S.E.,

AND

STROUD, GLOUCESTERSHIRE.

D. BRUCE PEEBLES & CO.,

ENGINEERS,

FOUNTAINBRIDGE WORKS, EDINBURGH,

MANUFACTURERS OF WET AND DRY GAS-METERS;

Patentees and Sole Manufacturers of PEEBLES' LAMP-GOVERNORS,

ABOVE 30,000 OF WHICH ARE NOW IN USE.

"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*

D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

Now ready, Second Edition, price 7s., by post 7s. 3d., the

GAS MANAGER'S HANDBOOK.

By THOMAS NEWBIGGING, A.I.C.E.

Orders to be sent to the Publisher,

WILLIAM B. KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

ALFRED WILLIAMS,

PHŒNIX FIRE-BRICK WHARF,

64, BANKSIDE, SOUTHWARK, LONDON, S.E.

GAS ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS, AND FOR THE

SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,

AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

TO GAS COMPANIES, PROPRIETORS, &c.

TWO Gentlemen, experienced in Gas Matters, would be glad to LEASE a WORK of medium size, and would guarantee a good interest.

Address No. 261, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

REQUIRED, a Fitter, capable of laying mains and services, and with a thorough knowledge of interior fitting. None but capable, steady, industrious men need apply. Good wages given.

Application, in own handwriting, to No. 260, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SITUATION WANTED as Manager, where the make is from 20 to 30 million cubic feet per annum. Eight years in last situation. Draughtsman and understands erection. Testimonials and references.

Address MANAGER, care of W. Brierley, 2, Bond Street, LEEDS.

GAS METER COMPANY, LIMITED.

WANTED, a Traveller to solicit for orders in the manufacturing towns of Lancashire, Yorkshire, Cheshire, and Derbyshire.

Terms will be liberal, and security required.

Applications, personally or by letter, to be made to Mr. W. W. ANDREWS, General Manager of the Company, 238, Kingsland Road, LONDON.

WANTED, a Man for Pipe Laying, Meter Repairing and Fixing, Index Reading, &c. To a steady, competent man the place will be comfortable. There is a free house beside the works.

Applications, stating wages expected, to be sent to Mr. JAMES WHYTE, Gas-Works, SEAHAM HARBOUR.

BARNET DISTRICT GAS AND WATER COMPANY.

WANTED, by the above Company, an intelligent and steady young Man as CLERK. Salary to commence at £50 per annum.

Applications, in candidate's own handwriting, stating age and other particulars, &c., to be forwarded immediately to Mr. T. H. Martin, Manager, Gas-Works, New Barnet, Herts.

By order,
ALFRED LASS, Secretary.

Offices, 60, Cornhill, London, April 28, 1876.

GAS MANAGER.

WANTED, for Holyhead Gas-Works, a competent MANAGER and Fitter, to take charge of the works and property of the Company. Must be able to keep accounts, execute any fitting required, &c. Salary £1 10s. per week, with residence, rent, taxes, coals, water, and light free on the works.

Application, in the candidate's own handwriting, with recent testimonials as to abilities, age, and character, to be sent not later than the 17th of May, 1876, to JOHN HUGHES, Castle House, HOLYHEAD.

BOROUGH OF NEATH, GLAMORGANSHIRE.

WANTED, by the Town Council of above Borough, a CLERK and Collector, competent to keep the accounts of the Neath Gas-Works (supplying a population of about 12,000), and to collect the gas-rents and other quarterly accounts. Salary £70 per annum, payable monthly. Month's notice.

Application, in own handwriting, stating age, whether single or married, present and recent employments, whether or not accustomed to accounts, and (if so), in what business, and with testimonials or references as to character, to be sent to this Office, endorsed "Application as Gas-Works Clerk and Collector," on or before the 6th of May next.

By order,
ALFRED CURTIS, Town-Clerk.

Town-Clerk's Office, Neath, April 27, 1876.

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

HINTS ON GAS BURNERS, &c.

By MAGNUS OHREN, A.I.C.E., F.C.S.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

ON SALE—Four Dry Lime Purifiers, each 5 ft. square; with lifting apparatus, centre-valve, and 8-in. connexion-pipes complete.

Apply to the CLERK of the Local Board, Atherton, near MANCHESTER.

ON SALE—A Gasholder, 16 ft. diameter and 10 ft. deep, with three cast-iron ornamental columns and one hydraulic main.

Address CRAVEN, DUNNILL, AND CO., Jackfield Works, Ironbridge, SALOP.

ON SALE—One Round Station-Meter, to pass 12,000 feet per hour, with 8-in hydraulic valves and bye-pass. Will be thoroughly overhauled and fitted with new drum. Also one 8-in. Anderson's Exhauster, with four driving pulleys, wall-box, &c.

Apply to J. AND J. BRADDOCK, Globe Meter-Works, OLDHAM.

FOR SALE, a Set of Four Purifiers, 8 feet square, dry centre-valve, grids, covers, and lifting gear, 8-inch connexions.

Also Two PURIFIERS, 12 feet by 6 feet, two hydraulic valves, grids, covers, 8-inch connexions.

Apply to S. STUDHOLME, Old Gas-Works, WHITEHAVEN.

FOR SALE, in consequence of enlarge- ments, 81 yards of 18-in. Cast HYDRAULIC MAINS, with 10-in. valves, branches, and dip-pipes, &c.; also a number of D MOUTHPIECES, 24 in. by 14 in.; and Round Mouthpieces, 18-in. diameter, with wrought-iron lids; and 5-in. and 6-in. by 5-in. ASCENSION-PIPES, all in good order.

Apply to CHARLES SELLERS, Gas-Works, YORK.

TO MANAGERS AND OTHERS.

A Small Quantity of 18-in. and 16-in. MAIN is required. Any one having a surplus to dispose of, may meet with a purchaser.

Address, by letter, No. 262, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Swansea Gaslight Company have for immediate SALE, the following Plant:—

A 6-h.p. Patent Trunk Engine. (Beale.)
Cylindrical Egg-ended Boiler, 20 ft. by 4 ft. 6 in. (Beale.)
Exhauster to pass 15,000 feet per hour. (Beale.)
An 8-h.p. Grasshopper Engine. (Easton and Amos.)
Cylindrical Egg-ended Boiler, 20 ft. by 4 ft. 6 in. (Easton and Amos.)
Exhauster, 20,000 ft. per hour. (Beale.)
Tar, Liquor, and Water Pumps, Eccentrics, Shafting, and Driving Pulleys.
Wrought-iron Condenser, six vertical Legs, 30 ft. high, 24 in. by 6 in., with tar-boxes, dips, and syphons.
Wrought-iron Scrubber, 5 ft. diameter, 20 ft. high.
Cast-iron Scrubber, 3 ft. diameter, 20 ft. high.
A set of four cast-iron Purifiers, 12 ft. square by 5 ft. deep, with galvanized wrought-iron covers, lifting apparatus, four tiers of wooden sieves, 10-in. connexions and valves.

May be seen at the Gas-Works, Swansea. The whole in perfect working order; replaced by plant of larger dimensions.

Further particulars may be obtained on application to Mr. THORNTON ANDREWS, SWANSEA.

ROCHDALE CORPORATION.

THE Gas Committee of the Rochdale Corporation invite TENDERS for 700 lineal yards of 8-in. Cast-Iron PIPES, turned and bored. Also sundry connexions.

All further information may be obtained from Mr. Paterson, Manager, Gas-Works.

Tenders, endorsed "Gas-Main," to be sent to me, on or before May 9, 1876.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
ZACH. MELLOR, Town-Clerk.

Town-Hall, Rochdale, April 28, 1876.

TO CONTRACTORS.

THE Drighlington and Gildersome Gas- light Company invite TENDERS for the excavation of and building a Brick TANK, 102 ft. diameter and 25 ft. deep.

Plans and specifications may be seen, and further particulars obtained, on application to the undersigned, at the Gas-Works, New Lane Bottom, Drighlington, to whom sealed tenders must be sent on or before Tuesday, the 9th day of May next, endorsed "Tenders for Gasholder-Tank."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
CHAS. ARMITAGE, Engineer and Secretary.

BOROUGH OF NEATH, GLAMORGANSHIRE.

THE Town Council of above Borough hereby invite TENDERS for the supplying and laying of about 920 yards of 4-in. and 6-in. MAIN-PIPES in extension of the existing mains along the turnpike road, known as Britonferry Road, such pipes to be provided and laid in accordance with specification, which may be seen at the Gas-Works Office, James Street, Neath.

Tenders, endorsed "Extension of Gas-Mains," to be sent in, under cover, to this Office, on or before Saturday, the 6th of May, 1876.

The Council do not pledge themselves to accept the lowest or any tender.

By order,
ALFRED CURTIS, Town-Clerk.

Town-Clerk's Office, Neath, April 26, 1876.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Birkenhead Improvement Com- missioners invite OFFERS for the purchase of the whole of the AMMONIACAL LIQUOR and surplus TAR produced at their works, for Two, Three, or Five years.

Further particulars can be obtained from the Engineer, at the Gas-Works.

Offers, addressed to the Chairman of the Gas and Water Committee, 50, Hamilton Square, to be sent in on or before the 12th of May next, and marked on the envelope "Offers for Tar and Ammoniacal Liquor."

The Commissioners do not bind themselves to accept the highest or any offer.

By order,
AMBROSE WALU, Clerk to the said Commissioners.

Birkenhead, April 20, 1876.

TO TAR DISTILLERS AND MANUFACTURING CHEMISTS.

THE Directors of the Blackburn Gaslight Company are prepared to receive TENDERS for the whole of the TAR and AMMONIACAL LIQUOR produced at their No. 1 and No. 2 stations for a term of One, Two, or Three years.

Sealed tenders, endorsed, to be addressed to Joseph Harrison, Esq., Chairman, and to be sent in on or before the 18th day of May next.

The Directors do not bind themselves to accept the highest or any tender.

Further information as to quality and quantity may be obtained of the undersigned.

By order,
SAMUEL R. OGDEN, Engineer and Manager.

TO IRONFOUNDERS AND CONTRACTORS.

THE Directors of the Exeter Gaslight and Coke Company are prepared to receive TENDERS for the supply of about 1500 yards of 22-in. Cast-Iron SOCKET-PIPES, with such syphons, tees, and bends as may be required.

The Pipes must be cast vertically in dry sand moulds, and coated with Dr. Angus Smith's patent preparation. The whole to be delivered as required, free from all imperfections, at Exeter.

Tenders to be sent to me, the undersigned, on or before Monday, May 15 inst., endorsed "Tender for Mains."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
W. A. PADFIELD, Secretary.

Gaslight Offices, Exe Island, Exeter, April 21, 1876.

TO COAL MERCHANTS, SHIPOWNERS, & OTHERS.

THE Directors of the Torquay Gas Com- pany are prepared to receive TENDERS for the supply of about 5000 tons (or such other quantity as may be agreed on) of Pelaw Main, Waldridge, Pelton, New Pelton, Peareth, or other approved GAS COAL. About 600 tons per month to be delivered during June, July, August, September, and October, and the remainder at the rate of about 400 tons per month during the succeeding five months.

The Company to have the option from time to time of taking either of the Coals specified in the Contract, and also of having the same delivered at Torquay, Paignton, or Dartmouth.

Tenders to state the price of the Coals and freight, separately and together, and also for delivery of the Coals into the Gas-Works, free of all charges.

Payment by cash for freight on delivery, and by three months bills for the Coal.

Further particulars to be obtained from Mr. Greenfield, the Manager of the Company, Hollacombe, Paignton, and tenders to be sent to the undersigned on or before the 12th day of May next.

By order,
J. KITSON, Secretary.

Torquay, April 26, 1876.

SULPHATE OF AMMONIA.

WHY sell your Liquor when it pays you better to work it up yourselves?

Consult J. JUDGE, Chemical Plumber, Burner, &c., who has put up several sets for Gas Companies with success. Saturating Tanks, &c., made to order. Success sure, and nuisance got rid of.

No. 96, NEW ROAD, WANDSWORTH ROAD, S.W.

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

NOTICE is hereby given that the ORDINARY GENERAL MEETING of the SHAREHOLDERS of the above Company will be held at the Offices of the Company, No. 60, Cornhill, in the City of London, on TUESDAY, the 23rd day of May inst., at Two o'clock in the afternoon precisely, to receive the Directors Report and the Accounts of the Company for the half year ending the 31st day of December last; to declare a Dividend; to elect Directors and an Auditor in the place of those retiring by rotation and to transact the general business of the Company.

The Transfer Books will be closed from the 10th to the 23rd inst., both inclusive.

By order of the Board,
ALFRED LASS, Secretary.

Offices, 60, Cornhill, London, April 25, 1876.

GAS AND WATER COMPANIES DIRECTORY.

THE EDITOR requests that the Forms sent to Secretaries and Engineers may be filled up and returned at once to 8, Buckingham Street, Adelphi, LONDON, W.C.

Price of Directory to Subscribers, 2s. 6d.

LLANELLY GAS-WORKS.

TO CONTRACTORS, BUILDERS, AND OTHERS.
CONTRACT No. 1.

THE Directors of the Llanelly Gaslight Company are prepared to receive TENDERS for the excavating and building of a Brick TANK, 92 ft. diameter and 25 ft. deep.

Drawings and specifications may be seen on application at the Gas-Works, Llanelly.

Sealed tenders to be sent in on or before Friday, May 19, addressed to the Chairman of the Gas Company, and endorsed "Tender for Tank."

The Company do not bind themselves to accept the lowest or any tender.

Further particulars may be obtained from the Engineer.

By order,
HENRY R. MARTIN, Secretary.

LLANELLY GAS-WORKS.

TO GASHOLDER MAKERS AND OTHERS.
CONTRACT No. 2.

THE Directors of the Llanelly Gaslight Company are prepared to receive TENDERS for the supplying, fixing, and completion of a GASHOLDER, 88 ft. diameter and 25 ft. deep, with all necessary guides, wheels, columns, and girders complete, to be erected at their Works, Llanelly.

Drawings and specifications may be seen on application at the Gas-Works, Llanelly.

Sealed tenders to be sent in on or before Friday, May 19, addressed to the Chairman of the Gas Company, and endorsed "Tender for Gasholder."

The Company do not bind themselves to accept the lowest or any tender.

Further particulars may be obtained from the Engineer.

By order,
HENRY R. MARTIN, Secretary.

YSTRAD GAS AND WATER COMPANY, YSTRAD, RHONDDA VALLEY, GLAMORGANSHIRE.

THE above Company desire Tenders for Taking Up about 2220 yards of 6-in. Pipes, and Laying the same number of yards of 9-in. Pipes complete, with all irregular pipes and castings in connexion with their No. 1 Gas Station.

For particulars, apply to Mr. J. L. Cocker, Gas-Works, Merthyr Tydfil, the Company's Engineer.

Tenders, addressed to Frank James, Esq., Solicitor, 134, High Street, Merthyr Tydfil, endorsed "Tender for Pipe-Laying," will be received up to Tuesday, the 9th of May, proximo.

The Directors do not undertake to accept the lowest or any tender.

By order of the Board,
FRANK JAMES, Secretary.

April 24, 1876.

BELFAST CORPORATION GAS-WORKS.

TENDER FOR COAL.

THE Gas Committee of the Belfast Cor- poration invite TENDERS for 50,000 tons of Best GAS COAL, to be delivered as under—viz.:

10,000 tons between the 15th of June and the first week in August next. Prices to be quoted either ex-ship, or delivered into the Gas-Works.

40,000 tons between the 1st of August, 1876, and the 30th of June, 1877, in monthly quantities, which may be known on application. Prices for this portion to be quoted ex ship, or in barges alongside the New Wharf at the Gas-Works.

Particulars will be supplied on application to Mr. James Stelfox, Manager, at the Works; and tenders, addressed to the Town-Clerk, will be received up till Wednesday, the 17th of May next.

The Committee do not bind themselves to accept the lowest or any tender.

JAMES GUTHRIE, Town-Clerk.

Town-Hall, Belfast, April 29, 1876.

EXTENSION OF TIME.
STOCKPORT BOROUGH GAS-WORKS.

TO CONTRACTORS, BUILDERS, AND OTHERS.
CONTRACT No. 1.

THE Gas Committee of the Corporation of Stockport are prepared to receive TENDERS for the excavating and building of a BRICK TANK, 144 ft. 6 in. diameter and 33 ft. deep, for their new works, Portwood, Stockport; also a Rubble Stone RETAINING WALL, about 100 yards long.

Drawings and specifications may be seen on application at the Heaton Lane Works, Stockport.

Sealed tenders to be sent in on or before Wednesday, the 10th of May, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Tank and Wall."

The Committee do not pledge themselves to accept the lowest or any tender.

Tenders must be upon forms supplied by the Gas Committee, signed by the contractor tendering, and properly witnessed.

Further particulars may be obtained from the Engineer.

By order,
JAS. JACQUES, Engineer and Manager.

Millgate Works, April 26, 1876.

GEORGE ORME & CO.,

ATLAS METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET AND DRY GAS-METERS,

STATION-METERS, GOVERNORS,

PRESSURE AND EXHAUST REGISTERS,

LAMP-METERS IN CAST-IRON BOXES,

And every Description of Gas Apparatus.

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DIBDALE FIRE-CLAY, BRICK, AND GAS-RETORT WORKS,

STOURBRIDGE (Established 1834),

MANUFACTURER OF EVERY DESCRIPTION OF

Burs, Lumps, Stays, Shields & other Bricks, & Gas-Retorts.

A LARGE QUANTITY OF RETORTS ALWAYS IN STOCK.

Circular . 14 in., 15 in., 16 in., 18 in.

Ovals . . 17 in. × 14 in., 17 in. × 15 in., 20 in. × 15 in., 21 in. × 15 in., &c.

D's. . . { 14 in. × 14 in., 15 in. × 12 in., 15 in. × 13 in., 17 in. × 14 in., 18 in. × 13 in.
{ 18 in. × 15 in., 20 in. × 16 in., 22 in. × 14 in., 24 in. × 14 in., 24 in. × 15 in., &c.

Special attention given to the execution of Export Orders.

JAMES MILNE & SON,

GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

EDINBURGH, AND

2, KING EDWARD STREET,

NEWGATE STREET, LONDON.

Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES,

CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

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LIMITED.

SOLE MANUFACTURERS OF

SPENCE'S PATENT DRY COPPERAS;

CONTRACTORS FOR THE

PURIFICATION OF COAL GAS BY OXIDE OF IRON, &c.;

PURCHASERS OF

AMMONIACAL LIQUOR AND SPENT OXIDE;

MAKERS OF

OXIDE AND OTHER PAINTS;

AND

GENERAL CHEMICAL MERCHANTS.

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J. T. B. PORTER & CO.,

GAS ENGINEERS,

MANUFACTURERS AND CONTRACTORS,

GOWTS BRIDGE WORKS,

LINCOLN.

ESTIMATES FOR GAS-WORKS OF ANY SIZE.

REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—It is most particularly requested that all Communications be addressed to the FIRM ONLY, as circumstances have arisen which render this necessary.

TO TAR DISTILLERS.

THE Directors of the Ipswich Gaslight Company invite TENDERS for the surplus TAR produced at their works for One year.

Tenders to be sent on or before Thursday, the 11th of May next.

E. GODDARD, Manager.

MIDDLESEX COUNTY LUNATIC ASYLUM, COLNEY HATCH.

THE Committee of Visitors of this Asylum are prepared to receive TENDERS for the purchase of GAS TAR and AMMONIACAL LIQUOR produced at the Gas-Works of the establishment, delivered at the Asylum.

For particulars apply to the ENGINEER at the Asylum.

The tenders to be sent in, addressed to the Committee of Visitors at the Asylum, before Ten o'clock in the forenoon of the 10th of May next.

GLASGOW CORPORATION GAS.

RESIDUAL PRODUCT WORKS TO BE LET, AND RESIDUAL PRODUCTS FOR SALE.

THE Glasgow Corporation Gas Commissioners are prepared to receive OFFERS for a LEASE of their RESIDUAL PRODUCT WORKS at Dawsholm, near Maryhill, and also for the PURCHASE of the TAR and AMMONIACAL LIQUOR produced at their Gas-Works there. The Lease to be for such term of years, from the 1st of July next, as may be agreed on. Offerers must offer a fixed rent of £1400 per annum, and also a further sum in respect of each ton of coal carbonized at the Dawsholm Gas-Works.

On application at the Gas Office (Manager's Department), 42, Virginia Street, intending offerers will receive orders for inspecting the works.

Conditions of Let may be seen in the hands of the Subscriber, from whom also forms of offer may be obtained, which will be received by him up to the 1st of June next.

The Commissioners do not undertake to accept the highest or any offer.

J. D. MARWICK, Clerk to the Commissioners.

City Chambers, Glasgow, April 27, 1876.

GAS SHARES.

MR. SANDELL, Gas Companies Accountant, having several inquiries by capitalists desirous of investing, would be glad to hear from holders desirous of selling, and also from those desirous of buying.

Address 4, Skinner's Place, Size Lane, LONDON, E.C.

G. A. BAILEY AND CO., Machinists, Manufacturers of all kinds of Indexes for Gas and Liquid Meters, Tell-Tales for Turnstiles, on an improved principle. Every description of Wheel and Worm Cutting any size, &c.

86, Crampton Street, Newington Butts, LONDON, S.E.

N.B.—Country Orders executed with despatch.

COST PRICE SHEETS.

MANUFACTURE AND DISTRIBUTION OF GAS. These sheets are the same as were laid before the Dublin Meeting of the British Association of Gas Managers; but in the REPRINT, NOTES have been added for the guidance of those using them. Copies of the two sheets may now be had, price 5s.

South Shields. W. J. WARNER.

PATRONIZED BY THE ROYAL ARSENAL, WOOLWICH.

FERGUSON, Builder and Contractor, Kite method of Repairing Church Spires and High Chimneys. Chimneys straightened, pointed, and hooped. Conductors supplied and fixed. Old Chimneys pulled down by a process requiring no scaffolding or stoppage of work, by competent workmen, under personal supervision.

12, Canal Road, MILE END.

PLUTONIC CEMENT,

For Repairing Gas-Retorts in Action, preventing Porosity, and reducing the Deposit of Carbon, is highly commended.

WILLIAM RICHARDSON,

GAS AND HYDRAULIC ENGINEER,

CHARLES HENRY STREET AND BISSELL STREET, BIRMINGHAM.

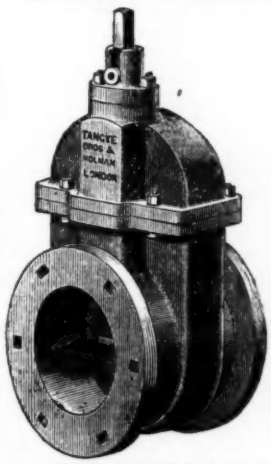
IMPROVED

GAS-VALVES,

AT GREATLY

REDUCED

PRICES.



Inch.	s.	d.
3	25	0
4	36	0
5	40	0
6	54	0
7	63	0
8	80	0
9	85	0
10	100	0
12	120	0
14	140	0

TANGYE BROS. & HOLMAN,

LAURENCE POUNTNEY LANE,

LONDON.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

D. M. NELSON,

48, GORDON STREET (late 135, BUCHANAN ST.),

GLASGOW,

Supplies every requisite in connexion with the distribution of Gas and Water.

Estimates and prices on application.

WOOD GRIDS for Purifiers and Scrubbers.

Cast-Iron PIPES and VALVES.

Street LAMP-PILLARS.

Patent Pipe SCREWING-MACHINES, &c.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

WATER-MAINS.

COTTERILL'S PATENT STEEL TUBE-DRILLS,

for connecting services to water-mains, *under pressure*, without turning off the water. They drill and tap themselves, and are left in the mains. Made of all sizes, from ¾ to 2 inches and upwards. They cost less than the ordinary plan.

Apply to CHARLES FORSTER COTTERILL, Cannock, STAFFORD, Patentee.

BIRTLEY IRON WORKS,

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DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. MANWARING, 161 Cannon Street, E.C.

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SUPPLY GAS & WATER PIPES of EVERY SIZE.

Plain, Turned and Bored, and Coated.

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Castings for Gas-Works of every description.

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MOBBERLEY & PERRY,

FIRE CLAY and BRICK WORKS,

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Manufacturers for Home and Export.

GAS-RETORTS, GLASS-HOUSE FURNACE,

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And Every Description of Best Fire-Bricks.

SZERELMEY

ANTI-CORROSIVE COMPOSITIONS.

SZERELMEY IRON PAINT having been in use for upwards of twenty years, has stood the test of time. SIR CHARLES BARRY reported to the Chief Commissioner of Works (in 1859) that the Iron Roofs of the Westminster Palace, coated in 1856, "Still afford the most convincing and satisfactory evidence of its efficacy," and anyone who looks at the work now, in 1876, will see the same evidence.

THE Undersigned have, by means of extensive machinery and improved processes, succeeded in reducing the price of the Szerelmey Iron Paint, that which was formerly sold at £55 they now supply at £33, and make other kinds, commencing at £20 per ton, including Black, Purple, Chocolate, Red, Green, Blue, Bronze Green, Grey, White, and various tints.

THE Szerelmey Liquid Enamel, sold ready for use, is the cheapest Anti-Corrosive Composition ever produced; it dries in four hours.

SZERELMEY Stone Paint thoroughly waterproofs brick and other walls without giving them the appearance of having been painted.

COPIES of the Reports of Sir Charles Barry, Sir R. J. Murchison, and Professor Faraday (printed by order of the House of Commons), with twenty years of favourable testimony,

Price lists, discounts, and all particulars may be had of

N. C. SZERELMEY & COMPANY

(LIMITED),

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JOHN HALL AND CO., STOURBRIDGE,

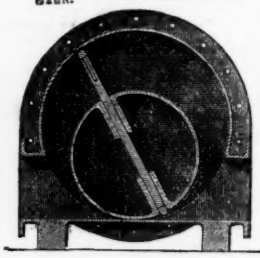
Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

TRADE MARK

J. BEALE'S PATENT GAS EXHAUSTER.



BEALE'S CONTINUOUSLY ACTING

GAS EXHAUSTERS

ARE NOW MANUFACTURED BY

B. DONKIN & CO.

MR. J. BEALE, of East Greenwich, having retired from business, has made an arrangement with B. DONKIN & CO. for the sole manufacture of his Patent Solid-Slide Gas Exhausters.

B. D. & Co. also make Steam-Engines to drive Gas Exhausters direct or otherwise, and Gas-Valves.

Estimates and Prices on application to

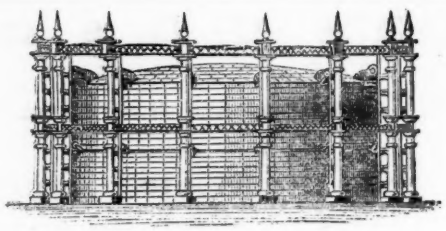
B. DONKIN & CO.,

ENGINEERS & IRONFOUNDERS,

55a, BLUE ANCHOR ROAD, BERMONDSEY,

LONDON, S.E.

HOPE IRON WORKS,



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ASHMORE & WHILE,

GAS ENGINEERS & CONTRACTORS,

MANUFACTURERS OF GASHOLDERS,

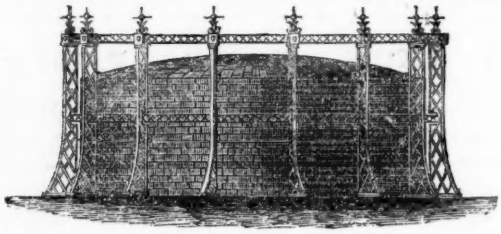
GAS APPARATUS OF EVERY DESCRIPTION,

Including Improved

Retort-Lids, Boilers, Cast and Wrought Iron Tanks, Iron Roofing, Bridges, Girders,

And GENERAL IRONWORK.

N.B.—Estimates for all Gas Plant and Remodelling supplied on application.



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LIMITED,

TIPTON, STAFFORDSHIRE.

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MANUFACTURERS OF

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AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

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Steam-Jet Engineers,

SOLE LICENSEES FOR

W. CLELAND'S PATENT STEAM-JET GAS-EXHAUSTER,

AND

W. CLELAND'S PATENT STEAM SCRUBBER,

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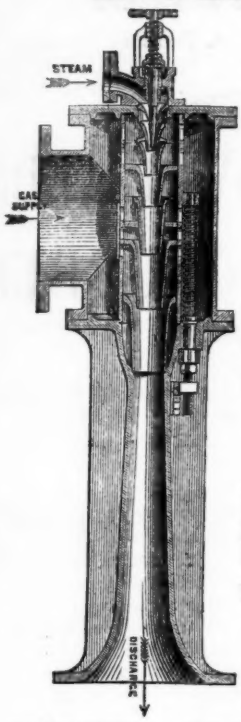
Austria: Kolring., Pestalozzigasse 6, Vienna.
France: 11, Rue Louis-le-Grand, Paris.
U. S.: 1645, N. 10th St., Philadelphia.



E. KÖRTING'S PATENT

STEAM-JET GAS-EXHAUSTER.

Small Cost—Compactness—Perfectly Self-Acting—
Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—
No Extra Room Required—No Wear and Tear—No Noise—
No Oscillation in Vacuum, or Back Pressure.

UPWARDS OF 200 IN USE.

SUPPLIED TO—

Chartered Gas Co.	Horsham Gas Co.	Bury Gas-Works.
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Phœnix Gas Co.	Cheltenham Gas Co.	Stalybridge Gas-Works.
Liverpool Gas Co.	Sandwich Gas Co.	Lincoln Gas-Works.
Bolton Corporation.	Cornholme Dis.Gas-Wks.	&c., &c., &c.

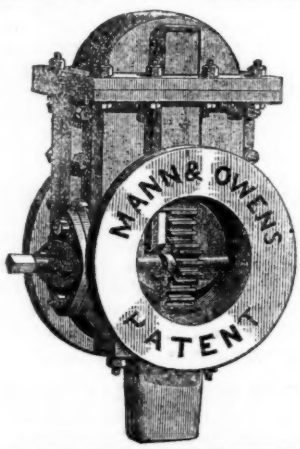
E. KÖRTING'S PATENT STEAM-JET REVIVIFYING BLOWERS FOR THE PURIFYING MATERIAL.

W. CLELAND'S PATENT STEAM SCRUBBER,
Combining small cost and thorough efficiency, with absence of any mechanical means and necessity of renewing the scrubbing material.

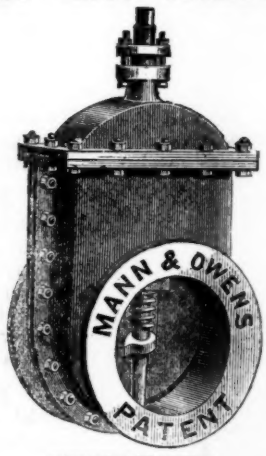
FOR PARTICULARS, APPLY TO

KÖRTING BROS., 7 and 17, Lancaster Avenue, MANCHESTER,
OR TO
GERALD J. TUPP, 8, John Street, Adelphi, W.C., LONDON,
SOLE AGENT FOR ENGLAND AND WALES.

MANN & OWENS' PATENT GAS-VALVE.



RACK AND PINION VALVE.



SCREW VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

SOLE MANUFACTURERS:

S. OWENS AND CO.,

HYDRAULIC AND GENERAL ENGINEERS,

WHITEFRIARS STREET, LONDON, E.C.

PRICES, SIZES AND FULL PARTICULARS ON APPLICATION.

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c., &c.,

SCOTSWOOD FIRE-BRICK WORKS,

SCOTSWOOD-ON-TYNE.

BELGIAN CLAY RETORTS.

J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

Communications addressed to J. SUGG & CO., GHENT, will receive immediate attention.

FIRE-CLAY RETORTS.

WILLIAM FRASER,

INVERKEITHING,

Owner of the Works at which Fire-Clay Retorts were first made), can supply

RETORTS, FIRE-BRICKS, &c.,

to any extent.

References can be given to managers of above a hundred Gas-Works whom he supplies.

He ships at Charlestown his

CELEBRATED HALBEATH STEAM COALS,

on Navy List.

JAMES NEWTON & SONS.

(Established 1820,)

FIRE-BRICK AND TILE MERCHANTS,

Wholesale and for Exportation,

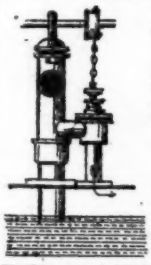
FALCON DOCK, 78 AND 79, BANKSIDE,

SOUTHWARK, LONDON, S.E.,

DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for

GAS AND WATER WORKS.

COPP'S PATENT ANTI-DIP GAS APPARATUS.



Produces from 10 to 20 per cent. more gas of higher illuminating power.
Prevents the deposit of carbon.
Retorts last much longer.
Charges work off quicker.
This simple invention has been in use in many works for the last six months, with the above results.

PRICE 2 GUINEAS EACH.

Testimonials and particulars on application.

Address WALTER L. COPP, WATCHET, SOMERSET.

LAMP-PILLARS,

GAS-LAMPS, FOUNTAINS.

Our New and Choice Designs for the above, with prices, are forwarded to any part of the world on receipt of twelve stamps. Estimates for work at home or abroad.

W. T. ALLEN & CO.,

GAS & WATER ENGINEERS & CONTRACTORS,

203, UPPER THAMES STREET,

LONDON, E.C.

C. & W. WALKER'S

WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

MIDLAND IRON-WORKS,

DONNINGTON, NEAR NEWPORT, SHROPSHIRE.

8, FINSBURY CIRCUS, LONDON.

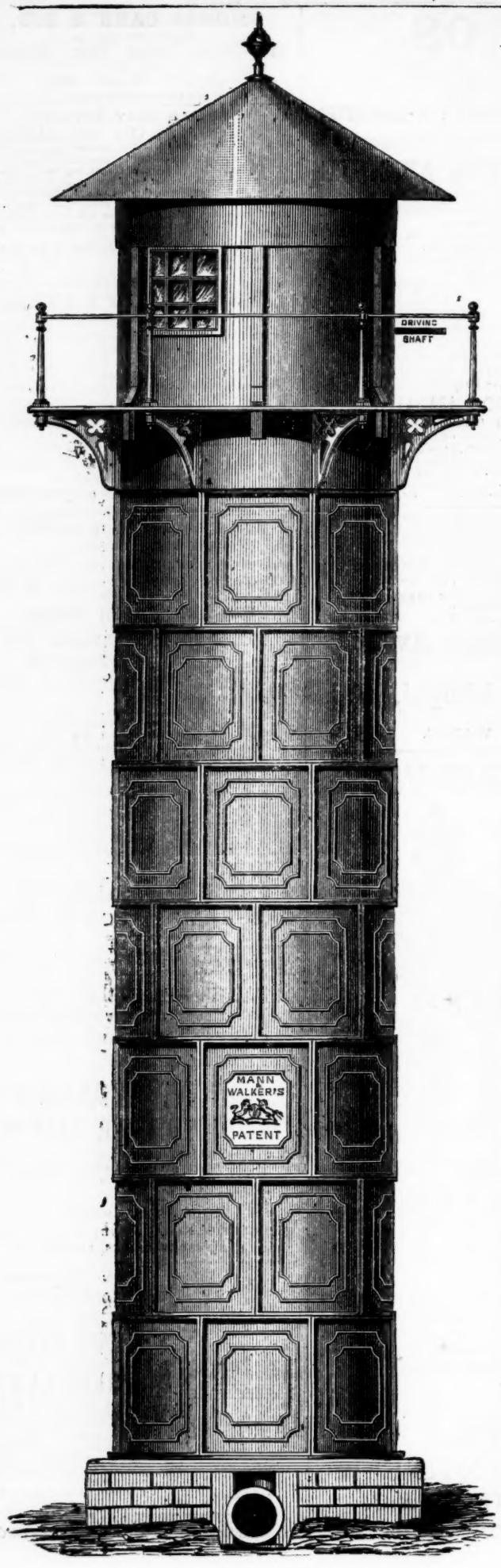
GAS COMPANIES AND LOCAL BOARDS Requiring New Street-Lamps are recommended A

KEEN'S PATENT DOUBLE-CLIP STREET-LAMP.

A great improvement on the old-fashioned 14-in. Lamps. They have been sold to various Gas-Works throughout B the country and abroad, and the highest satisfactory testimonials are given as to their superiority.

For particulars of price, &c., apply to

WILLIAM KEEN, Sole Proprietor and Manufacturer, Robertson Street, HASTINGS.



C. & W. WALKER,
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MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im-portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, re-quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us. C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

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OF THE HIGHEST EXCELLENCE ONLY;

ALSO LICENSEES AND MANUFACTURERS OF

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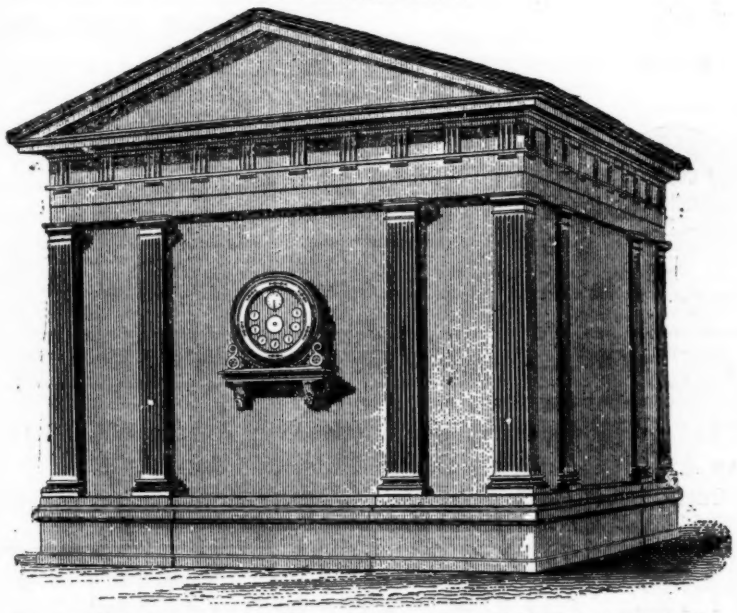

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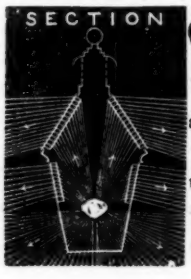

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Cubic feet of Gas yielded per ton . . .	10,050
Illuminating power in sperm candles . .	15·4
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One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

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PRESENT PRICE:
5s. 6d. per Ton at Pit.
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Cubic Feet.	Illuminating Power.	Coke (sup. qual.).
10,000 ..	20 candles. ..	12 cwt.

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This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

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Has on hand a quantity ready for immediate delivery, and is prepared to contract for Supplies during the years 1876 and 1877.

Can strongly recommend his real OLD SILKSTONE GAS COAL, which will give, in regular work, 10,200 feet 16·6-candle gas, and 12 cwt. superior coke.

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STRONGLY RECOMMEND A TRIAL OF THEIR

CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

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JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

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Purified gas per ton of coal in cubic feet (average)	**10,775**
Weight of coke in lbs. per ton of coal	**1,465**

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Works: LOCHORE by LOCHGELLY, FIFESHIRE. Office: CUSTOM HOUSE CHAMBERS, LEITH.

This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.		Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	..	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	..	34·83
Value of 1 cubic foot of gas in grains of sperm	780	..	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	..	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	..	71 minutes.
Gravity of the gas (air = 1000)	596	..	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.		Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	..	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	..	33·09
Value of 1 cubic foot of gas in grains of sperm	878	..	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	..	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	..	67 minutes.
Gravity of the gas (air = 1000)	677	..	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company.

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